SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI

THREE /FOUR YEAR DEGREE OF BACHELOR OF SCIENCE

B.Sc. BOTANY
Semester - III and IV

FACULTY: SCIENCE AND TECHNOLOGY

(Courses effective from Academic Year 2025-26)
Under NEP 2020

SYLLABUS

Table of Contents

TLE Scheme for SECOND YEAR: SEMESTER – III

Mode of Teaching	Ver. No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major	MJ-Theory	107212	Microbial Diversity and Cryptogams-I	2	2	8
			MJ-Theory	107213	Cryptogams-II and Gymnosperms	2	2	
			MJ-Practical-8	107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms	2	4	
		IKS-Major Specific	IKS -Theory	107215	Sacred Plant Heritage of Maharashtra	2	2	
	b.	Minor	Mn-Theory	107216	Plant Diversity, Conservation and Forensic Botany	2	2	6
			Mn-Practical-9	107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany	2	4	
	c.	Generic/ Open Elective	GOEC-Theory	107218	Traditional Health Care	2	2	2
	d.	VSC	Practical-10	107219	Supply Chain Management in Seed Products	2	4	4
	e.	AEC - English	Theory		Refer University basket	1	1	2
		AEC –MIL	Theory		Refer University basket	1	1	
	f.	FP/CES	Project	107220	Field Project / Community Engagement Services in Botany: **Phase-I**	2	4	8
		CC	Outdoor		Separate SOP will be released	2	4	
		TOTAL				**22**	**30**	**30**

Important:

- VSC Should be Complementary to Major
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

TLE Scheme for SECOND YEAR: SEMESTER – IV

Mode of Teaching	Vertical No	The Vertical	Type of Course	Course Code	Course Name	Credits	Workload (Hrs/Week)	Vertical Workload (Hrs/Week)
Classroom Teaching / Lab Work (Practical)/ Outdoor / Field	a.	Major	MJ-Theory	107221	Botanical Wealth – Economic Botany, Ethnomedicine and Phytochemistry	2	2	8
			MJ-Theory	107222	Cellular Frontiers in Botany - Cell Biology, Cytogenetics and Molecular Biology	2	2	
			MJ-Practical-11	107223	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies	2	4	
	b.	Minor	Mn-Theory	107224	Plant Propagation and Growth	2	2	6
			Mn-Practical-12	107225	Investigations of Plant Life Sketch	2	4	
	c.	Generic/ Open Elective	GOEC-Theory	107226	Wonders of Plant World	2	2	2
	d.	VSC	Practical-13	107227	Nursery and Garden Management	2	4	8
		SEC	Practical-14	107228	Skilling Botanists for Nursery and Garden Management	2	4	
	e.	AEC - English	Theory		Refer University basket	1	1	2
		AEC –MIL	Theory		Refer University basket	1	1	
	f.	FP/CES	Project	107229	Field Project / Community Engagement Services in Botany: **Phase-II**	2	4	8
		CC	Outdoor		Separate SOP will be released	2	4	
		TOTAL				**22**	**34**	**34**

Important:

- VSC Should be Complementary to Major
- SEC has to be selected from the Basket Provided by University, from the same Faculty/Discipline of the Major/Minor

Notes:

a. The strength of the batch of the Practical for UG Classes shall be 16 with an addition of 10% with the permission of Hon'ble Vice Chancellor. The number of the students required to constitute a batch or calculate the workload shall be in accordance with the relevant Government Resolution in force at the time, applicable to specific time, region, course type, mode of instruction, and other pertinent factors.

b. 1 Credit shall mean 1 Hour Teaching per Week per Semester (Total 15 Hrs/ Semester), the duration of 1 Teaching Period will be 60 Minutes. For Practical 1 Credit shall mean 2 Hour Teaching per Week per Semester (Total 30 Hrs/ Semester).

c. For Examination and Evaluation of Theory Courses, 40 % Marks shall be assigned to Internal Examination and 60% Marks shall be assigned to end-semester external university examination.

d. **Co-curricular Courses:** Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III, IV, V and VI**.** These courses may be taught by Physical Education Director or may be assigned to Language Teacher by the Principal of HEI based on the expertise of the concerned.

e. **Value Education Courses** to be selected from the Basket of Courses provided by the University. These courses may be assigned to the Language Teacher by the Principal of HEI based on the expertise of the concerned.

f. **Generic / Open Elective Courses (GE/OE):** Courses to be selected from the Basket of Courses provided by the University

g. **Abbreviations:** Department Specific Core: DSC, Department Specific Elective: DSE, FSC: Faculty Specific Core, FSE: Faculty Specific Elective, Indian Knowledge System: IKS, Inter Faculty Specific Core: IFSC, Inter Faculty Specific Elective: IFSE, Theory: Th, Practical/Practicum: Pr, Environment Studies: ES, Pre-requisite Course mandatory if applicable: Prq, Laboratory: Lab (Practical), Generic/ Open Electives: OE; Vocational Skill and Skill Enhancement Courses: VSEC; Vocational Skill Courses: VSC; Skill Enhancement Courses: SEC; Ability Enhancement Courses: AEC; Value Education Courses: VEC; OJT: On Job Training: Internship/ Apprenticeship; Field projects: FP; Community Engagement and Service: CES; Co-curricular Courses: CC; RM: Research Methodology; Research Project: RP; MIL: Modern Indian Language

Examination and Assessment Process:

i. The basic principle of the Credit framework is that Credits are a function of the successful completion of a program of study/ vocational education/ training and assessment. No Credit can be earned by the student unless the student is assessed for the achievement of the desired competencies and outcome of a program.

ii. Exit options are provided with Certificate, Diploma and Basic Bachelor's degrees to the students at the end of the second, fourth and sixth semesters of a Four Years Multidisciplinary Degree Programme. Students will receive a Bachelor's degree with Honors/ Research on successfully completing of all eight semesters of the UG Program either at a stretch or with opted exits and re-entries.

iii. For the smooth success of four-year degree programme with multiple entry and exit systems, the examination mode should be based on the combination of innovative trends in formative (informal and formal tests administered during the learning process) and summative (evaluation of students learning at the end of an instructional unit) examination modes in line with the UGC Report on 'Evaluation Reforms in Higher Educational Institutions (2019).

Examination, Evaluation and Assessment Scheme

The total marks for each Course shall be based on Continuous Assessment and Semester End Examination. Each theory course of Major, Minor, GE/OE, AEC, IKS, VEC as mentioned in **Teaching Learning Scheme** prepared by the Board of Studies shall be evaluated as per the scheme as mentioned in the following table -

Examination, Evaluation and Assessment Scheme

Vertical No.	The Vertical	Mode of Examination, Evaluation & Assessment	Theory				Theory (Total)		Practical				Practical (Total)	
			External		Internal				External		Internal			
			Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks	Max. Marks	Min. Marks
a	Major	External & Internal	30	9	20	6	50	20	25	10	25	10	50	20
b	Minor		30	9	20	6	50	20	25	10	25	10	50	20
c	Generic/ Open Elective		30	9	20	6	50	20	--	--	--	--	--	--
d	VSC	Internal	--	--	--	--	--	--	--	--	50	20	50	20
	SEC	Internal	--	--	--	--	--	--	--	--	50	20	50	20
e	AEC (Eng. & One MIL Composite)	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
	IKS (Generic)	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
	VEC	External & Internal	30	9	20	6	50	20	--	--	--	--	--	--
F	FP/CEP	Internal	--	--	--	--	--	--	--	--	50	20	50	20
	Internship/ Apprenticeship		Assessment of these verticals shall be based on various activities/practices. It shall be evaluated by giving maximum marks of 50 per 2 Credit Course with separate activity weightages/levels. A detailed SOP for this assessment process is prescribed for Phase I and Phase II											
	CC													

Continuous Assessment Tests (CAT)

For internal assessment, the Continuous Assessment Tests (CAT) shall be conducted as under-

i. Three CAT each of 8 / 10 Marks (Theory) as applicable and 10 Marks (Practical).
   - First on completion of 25% Syllabus of the course or on completion of 25 teaching days,
   - Second on completion of 50% Syllabus of the course or on completion of 50 teaching days,
   - Third on completion of 75% Syllabus of the course or on completion of 75 teaching days.

ii. Each concurrent assessment (CAT-I, II & III) will be mapped to relevant Course Learning Outcome.

iii. Total Performance in CAT (i.e. 40 %) shall be based on the **best two out of three** in CAT examinations

iv. Internal assessment shall be carried out by the respective course teacher by choosing variety of assessment tools/methods such as class test, record book, seminar, case study, field work, mini project work, quiz or any innovative method, which may be deemed to be appropriate for assessing the relevant course outcome.

Conduction of the Examination:

As per the scheme of teaching, learning, examination and evaluation, theory/practical examinations of Semester-I, II, III, IV, V, VI, VII and VIII shall be conducted by the University (except for Internal Examinations as applicable) at the end of each semester.

The theory/practical examinations of all the Semesters shall be held as per the following Schedule –

Sr. No.	Name of the Examination	End Sem Examination	Supplementary Examination*
1	Semester-I, III, V and VII	Winter	Summer
2	Semester-II, IV, VI and VIII	Summer	Winter

***** The University may evolve mechanism for conducting repeat end semester examination. Such repeat examinations shall have to be conducted within one month of the regular even semester examination and on demand examination.

1. The practical examination of all semesters shall be conducted by the University at the end of each semester. The HEI shall conduct the Practical examination of odd semesters as per the schedule announced by the University. **However, the appointment of the External and Internal Examiners shall be done by the Head or Principal of respective HEI to conduct external examination of the odd semester and the same should be communicated to the University before commencement of the practical examination.** The University shall conduct the external practical examination of all even semester by appointing external and internal examiners.
2. The examinations specified above shall be held twice in a year at such places and on such dates as may be prescribed by the University.
3. An applicant to an examination specified above, shall pursue a regular course of study in courses prescribed for the examination concerned for not less than one semester in a particular semester in a College/Institute/University department.
4. Provided that the student shall be eligible to appear for examination if -
   a. He/she complies with the provisions of the Ordinance pertaining to the Examination in general from time to time.
   b. He/she has prosecuted a regular course of study in a university department/college affiliated to the University.
   c. He/she has in the opinion of the Principal shown satisfactory progress in his/her studies.
5. The provisions of Ordinance No. 6 and Ordinance No. 9 shall be *mutatis-mutandis* applicable to every collegiate/non-collegiate student.
6. The fees for each theory examination and practical examination conducted by the university shall be as prescribed by the University, from time to time.

SEMESTER – III

Type of Course	Course Code	Course Name
MJ-Theory	107212	Microbial Diversity and Cryptogams-I
MJ-Theory	107213	Cryptogams-II and Gymnosperms
MJ-Practical-8	107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms
IKS -Theory	107215	Sacred Plant Heritage of Maharashtra
Mn-Theory	107216	Plant Diversity, Conservation and Forensic Botany
Mn-Practical-9	107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany
GOEC-Theory	107218	Traditional Health Care
Practical-10	107219	Supply Chain Management in Seed Products
Project	107220	Field Project / Community Engagement Services in Botany: Phase-I
Outdoor		Separate SOP will be released

Major Course: Microbial Diversity and Cryptogams I

Level	Semester	Course code	Course Name	Credits	Teaching Hrs	Exam Duration	Maximum Marks
5.0	III	107212	Microbial Diversity and Cryptogams-I	02	30	2.00 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To impart the knowledge of diversity, life forms, life cycles, morphology, and the importance of microorganisms (Viruses, Bacteria, algae, and fungi).
- To illustrate the fundamentals of different groups of microbes in nature and their features and role in a balanced ecosystem and economic importance.
- To present perspectives about microbes and their ecological and economic applications.
- Foster critical thinking and skills through the study of microbes and encouraging students to apply this knowledge suitable field.

Course Outcome

- Students would have an understanding of the classification, characteristic features, cell structure, and growth and reproduction in viruses, bacteria, algae, and fungi.
- Students would gain an understanding of the ecological and economic importance of different groups of microbes.
- Students will well verse with fundamental techniques of identification and culture of microbes.
- Students will be able to identify various plant diseases caused by microbes.
- Understand the basics of host-parasite relationship.
- Gain knowledge about various types of lichens and their importance.

Unit	Content	Workload Allotted (Hrs)	Weightage of Marks	Incorporation of pedagogies
I	**Introduction to Microbial Diversity**	07	07	Use any pedagogical technique suitable for the topic
	1.1 Definition and scope of microbial diversity. General characters and morphology of Viruses			
	1.2 Replication of viruses (Lytic and lysogenic cycle)			
	1.3 TMV: Structure, composition, symptoms, transmission, and control.			
	1.4 Economic Importance of Viruses (Vaccine Production, Gene therapy, and Cancer therapy)			
II	**Bacterial Diversity**	07	07	
	2.1 Archaebacteria- General Characters, Major Types and Their Significance			
	2.2 General characters and cell structure of eubacteria			
	2.3 Cyanobacteria – Cell structure, reproduction of Nostoc and economic importance			
	2.4 Reproduction in bacteria (Conjugation, transformation and transduction			

III	**Thallophytes: Algae**			
	3.1 Algae: General Characteristics and classification by F. F. Fritsch (1945)	08	08	
	3.2 General characters, thallus and reproductive structures of Chlorophyceae (*Oedogonium)* & Xanthophyceae (*Vaucheria)*.			
	3.3 General characters, thallus and reproductive structures of Phaeophyceae (*Ectocarpus)* & Rhodophyceae *(Batrachosprmum)*			
	3.4 Applications of Algae in various sectors (Food, Agriculture and Medicine)			
IV	**Thallophytes: Fungi**			
	4.1 General characteristics of fungi General characters of Mastigomycotina. Thallus and Reproductive structures of *Albugo*.	08	08	
	4.2 General characters, thallus and reproductive structures of Zygomycotina (*Rhizopus)* & Ascomycotina (A*spergillus).*			
	4.3 General characters, thallus and reproductive structures of Basidiomycotina (*Agaricus)* & Deuteromycotina (*Alternaria*)			
	4.4 Lichen-General characters, types, and economic importance; Applications of Fungi in various sectors (Food, Agriculture and Medicine)			

Activities for Continuous Assessment Test (CAT):	
1.	Bacterial Gram Staining
2.	Collect and identify algal forms from local sites.
3.	Collection and identification of fungal forms from local sites
4.	Culturing of some algal forms form mass production.
5.	Culturing and identification of fungal forms
References:	

- Alexopolus, C. J. and Bold, H. C. (1967). Algae and Fungi., Macmillen Publishing, New York (Internet Archive)
- Anantnarayan, R. and Paniker, J. (2024). A Text Book of Microbiology, 13th Edition. Universities Press, (India) Pvt. Ltd.
- Awasthi, A. K. (2015). Textbook of Algae, Vikash Publishing India
- Bendre, A. M. &Kumar, A. (2010). A Text Book of Practical Botany- I, Rastogi Publication
- Dubey, R. C., and Maheshwari, D. K. (2014). A Text Book of Microbiology, S Chand Publisher
- Dubey, R. C., and Maheshwari, D. K. (2014). Practical Microbiology, S Chand Publisher
- Gangulee, H.C. and Kar, A.K., (2011). College Botany Vol. II- New Central Book Agency, Kolkata

- Ganguli, H. C., Das, K.S.K. & Dutta, C.T. (2010). College Botany, Vol. I, New Central Book Agency , Kolkata
- Koche, D. K. & Shirsat, R. P. (2025). Textbook of Microbial Diversity, BP International
- Kumar, H.D. (1999). Introductory Phycology, 2nd edition. New Delhi, Delhi: Affiliated East-West Press. Lee, R.E. (2008). Phycology, 4th edition. Cambridge, Cambridge: Cambridge University Press,
- Pandey, B. P. (1999). Modern Practical Botany- Vol. I, S Chand Publication
- Pelczar, M.J. (2001). Microbiology, 5th edition. New Delhi, Delhi: Tata McGraw-Hill Co.
- Prescott, L.M., Harley J.P., Klein D. A. (2005). Microbiology, 6th edition. New Delhi, Delhi: McGraw Hill.
- Sharma, Kanika (2011). A Text Book of Microbiology, Ane Books, Pvt. Ltd.
- Sharma, P. D. (2011). Microbiology, Rastogi Publication
- Singh, Pande, Jain, (2010). A Text Book of Botany, Rastogi Publication, Meerut.
- Tortora, G., Funke, B. and Case C. (2018). Microbiology: an introduction, Pearson Publishing.
- Varnam, A. and Evans, M. (2000). Environmental Microbiology, Mansan Publishing Ltd.
- Vasanthakumari, R. (2016). Textbook of Microbiology, Wolters Kluwer India

1 Mark Questions (Answer in One Sentence)

Unit I: Microbial Diversity

1. Define microbial diversity.
2. What is the structure of a virus?
3. Name two types of viral replication.
4. What is TMV?
5. State one symptom of YVMV.
6. Mention one economic use of viruses.

Unit II: Bacterial Diversity

7. What are archaebacteria?
8. Name any two types of archaebacteria.
9. What is the composition of a eubacterial cell wall?
10. Name a cyanobacterium.
11. Mention any one method of bacterial reproduction.

Unit III: Thallophytes – Algae

12. Define algae.
13. Who classified algae in 1945?
14. Name one member of Chlorophyceae.
15. Give an example of brown algae.
16. Which pigment is found in red algae?

Unit IV: Thallophytes – Fungi

17. What is Albugo?
18. Name the asexual spore in Rhizopus.
19. Mention one medicinal use of fungi.
20. What is a lichen?

3 Mark Questions (Short Answer)

Unit I: Microbial Diversity

1. Write a short note on microbial diversity.
2. Differentiate between lytic and lysogenic cycle.
3. Explain structure and symptoms of TMV.
4. Describe symptoms and control measures of YVMV.
5. Mention three applications of viruses.

Unit II: Bacterial Diversity

6. List the major characteristics of archaebacteria.
7. Describe the cell structure of eubacteria.
8. Explain reproduction in Nostoc.
9. Write any three economic uses of cyanobacteria.

10. Explain conjugation, transformation, and transduction in bacteria.

Unit III: Thallophytes – Algae

11. Mention the general characters of algae.
12. Describe the thallus and reproduction of Oedogonium.
13. Write a short note on Vaucheria.
14. Describe structure and reproduction of Batrachospermum.
15. Write any three uses of algae in food, agriculture, or medicine.

Unit IV: Thallophytes – Fungi

16. Write general characteristics of fungi.
17. Describe thallus and reproduction in Albugo.
18. Explain the reproductive structure of Aspergillus.
19. Mention different types of lichens.
20. State three applications of fungi in various industries.

6 Mark Questions (Long Answer)

Unit I: Microbial Diversity

1. Explain lytic and lysogenic cycles in detail with diagrams.
2. Describe the symptoms, transmission, and control of TMV.
3. Discuss the economic importance of viruses in modern biotechnology.

Unit II: Bacterial Diversity

4. Write a detailed account on archaebacteria: types, characters, and significance.
5. Explain in detail the three types of bacterial reproduction.
6. Describe the cell structure and reproduction of Nostoc.

Unit III: Thallophytes – Algae

7. Explain F. E. Fritsch's classification of algae.
8. Compare thallus and reproduction in Oedogonium, Vaucheria, and Ectocarpus.
9. Describe thallus and reproductive organs in Oedogonium,
10. Describe thallus and reproductive organs in Vaucheria
11. Describe thallus and reproductive organs in Ectocarpus.
12. Discuss the applications of algae in food, agriculture, and medicine.

Unit IV: Thallophytes – Fungi

10. Describe thallus and reproductive structure of Albugo.
11. Describe thallus and reproductive structure of Rhizopus.
12. Describe thallus and reproductive structure of Aspergillus.
13. Explain general characters of Basidiomycotina and Deuteromycotina with examples.
14. Describe the types and economic importance of lichens.

Major Course: Cryptogams II and Gymnosperms

Level	Semester	Course code	Course Name	Credits	Teaching Hrs	Exam Duration	Maximum Marks
5.0	III	107213	Cryptogams II and Gymnosperms	02	30	2.00 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To recall general characteristics, classification, and contributions of botanists in Bryophytes, Pteridophytes, Gymnosperms, and Palaeobotany.
- To understand morphological and reproductive structures of selected plant groups and their significance.
- To apply knowledge for ecological and conservation importance of these plants.
- To correlate fossil plants with their modern counterparts.
- To examine contributions of eminent scientists in plant taxonomy.
- To analyze evolutionary relationships among plant groups.
- To evaluate the role of fossils and economic importance of these plants.

Course Outcome

- Recall and describe characteristics and contributions in plant taxonomy.
- Illustrate and explain structures and reproduction of selected plants.
- Apply practical knowledge in plant identification and preservation.
- Differentiate evolutionary affinities among plant groups.
- Evaluate economic and ecological importance of these plants.
- Propose conservation strategies for endangered species.

Unit	Content	Workload Allotted (Hrs)	Weightage of Marks	Incorporation of pedagogies
I	**Bryophytes:**	07	07	Use any pedagogical technique suitable for the topic
	1.1 General Characters, Classification (Smith, 1955)			
	1.2 Thallus & reproductive structure of *Marchantia*			
	1.3 Thallus & reproductive structure of *Funaria*			
	1.4 Economic and ecological importance of Bryophytes			
II	**Pteridophytes**	**08**	**08**	
	2.1 General Characters, Classification (K. R. Sporne, 1975)			
	2.2 Thallus & reproductive structure of *Equisetum* and *Marsilea*.			
	2.3 Types of stele, Heterospory, and Seed habit			
	2.4 Economic importance of Pteridophytes and Ornamental Pteridophytes.			
III	**Gymnosperms**	**08**	**08**	
	3.1 General Characters and Classification (Bierharts, 1971).			
	3.2 Plant Body and Reproductive Structures of *Pinus*			

	3.3 Plant body and reproductive structures of *Gnetum*			
	3.4 Economic importance of gymnosperms and Endangered gymnosperms (*Ginkgo biloba*)			
IV	Paleobotany	07	07	
	4.1 Geological time scale and types of fossils.			
	4.1 Fossil Pteridophytes (*Rhynia*) Fossil Gymnosperms (*Lygenopteris*)			
	4.2 Contribution of Prof. Birbal Sahni Affinities of Bryophytes with Pteridophytes			
	4.3 Affinities of Pteridophytes with Gymnosperms and Affinities of Gymnosperms with Angiosperms			

Activities for Continuous Assessment Tests (CAT):	
1.	Collection and photography of various Cryptogams (Bryophytes and Pteridophytes) in your local area.
2.	Survey the gymnosperms plants inhabiting in your area (Public, Institutional and Personal gardens), describe them, and prepare a report.
3.	Microscopic observations of locally available bryophytes, pteridophytes and gymnosperms.
4.	To understand the ecological importance of Cryptogams.

References

- Biswas, C. and Johri, B. M. (2014). The Gymnosperms, Springer Publication.
- Chandra, T. H. (1998). *Reproductive biology of pteridophytes*. The Indian Botanical Society.
- Gupta, M. K. (2001). *Environmental adaptations of gymnosperms in harsh climates*. Springer.
- Gupta, P. K. (2007). *Bryophytes: Diversity and evolution*. Oxford & IBH Publishing Co. Pvt. Ltd.
- Hegde, M. C. L. (1986). *Gymnosperms*. The National Book Trust.
- Jain, S. K., & Maheshwari, J. K. (1997). *Bryophytes: A guide for teachers and researchers*. International Book Distributors.
- Kaur, Inderdeep (2023) Textbook of Pteridophytes, Astral International Pvt. Ltd.
- Keshwani, G. C. (1984). *The liverworts and hornworts of India*. Botanical Survey of India.
- Mohan, J. (1999). *Practical manual on pteridophytes*. S. Chand & Company Ltd.
- Mohanti, C. (2018). Text book of Bryophytes, Pteridophytes and Gymnosperms, Kalyani Publication.
- Owens, D. A. (1997). *Reproductive strategies and evolution in gymnosperms*. Botanical Journal of the Linnean Society, 124(1), 101-113.
- Raghavan, V. S. (1995). *Practical manual on gymnosperms*. J. P. Publications.
- Rajendran, S. (2004). *Practical botany: Pteridophytes*. MJP Publishers.
- Rangland, A. and Kumaresan, V. (2016). College Botany Vol. 3 (Bryophytes, Pteridophytes, Gymnosperms and Paleobotany, Saras Publication.
- Rao, K. V. (1987). *Pteridophytes: Diversity and classification*. Wiley Eastern Ltd.
- Richards, P. M. (2001). *Bryophyte biology*. Cambridge University Press.
- Sharma, B. R. (2000). *Introduction to gymnosperms*. Oxford & IBH Publishing Co.

- Sharma, O. P. (n.d.) Gymnosperms, Pragati Publication
- Sharma, O. P. (2017). Pteridophyta, McGraw Hill Education.
- Sinha, B. B. (1992). *Practical botany: Bryophytes*. Vishal Publishing Co.
- Smith, A. R. (1995). *Ferns and allied plants*. Cambridge University Press.
- Smith, G. M. (2022) Cryptogamic Botany: Bryophytes and Pteridophytes Vol-II. Surjeet Publication.
- Sporne, K. R. (2022). The morphology of Pteridophytes: The structures of ferns and allied plants. Legare Street Press.
- Vashishta, P. C. (2010) Botany for Degree College, Pteridophyta. S. Chand Publication

1-Mark Questions (Answer in One Sentence)

Unit I: Bryophytes

1. What are bryophytes?
2. Name the classification system of bryophytes given by Smith.
3. Which bryophyte shows a thalloid plant body?
4. What is the sex organ in Marchantia?
5. Name the reproductive structure in Funaria.
6. Mention one ecological role of bryophytes.

Unit II: Pteridophytes

7. What are pteridophytes?
8. Who gave the classification of pteridophytes in 1975?
9. Which type of stele is found in Equisetum?
10. Define heterospory.
11. Name an ornamental pteridophyte.
12. Mention one economic importance of pteridophytes.

Unit III: Gymnosperms

13. Define gymnosperms.
14. Who classified gymnosperms in 1971?
15. Name the male reproductive structure in Pinus.
16. Name the gymnosperm with vessel elements.
17. Mention one economic product obtained from gymnosperms.
18. Give the name of an endangered gymnosperm.

Unit IV: Paleobotany

19. What is paleobotany?
20. Define fossil.
21. Name a fossil pteridophyte.
22. Who was Prof. Birbal Sahni?
23. Name one similarity between bryophytes and pteridophytes.
24. Mention one affinity between gymnosperms and angiosperms.

3-Mark Questions (Short Answers)

Unit I: Bryophytes

1. Describe general characters of bryophytes.
2. Write a short note on Smith's classification of bryophytes.
3. Describe the thallus structure in Marchantia.
4. Describe the reproduction in Marchantia
5. Describe the reproduction in Funaria.
6. Mention any three economic or ecological roles of bryophytes.

Unit II: Pteridophytes

6. Describe the general characters of pteridophytes.
7. Write a note on K.R. Sporne's classification.
8. Describe the morphological structure of Equisetum.
9. Describe the reproduction of Equisetum.
10. Explain is heterospory with suitable example.
11. Mention three economic uses of pteridophytes.

Unit III: Gymnosperms

11. Mention general characters of gymnosperms.
12. Describe the morphological characters of Pinus
13. Describe the reproductive structures of Pinus.

14. Describe the morphological structure of Gnetum.
15. Explain the reproductive structures of Gnetum.
16. Write any three economic uses of gymnosperms.

Unit IV: Paleobotany

16. Draw and explain a geological time scale.
17. Write a short note on Rhynia as a fossil pteridophyte.
18. Explain the significance of Birbal Sahni in Indian paleobotany.
19. Mention three affinities between bryophytes and pteridophytes.
20. Describe any three similarities between gymnosperms and angiosperms.

6-Mark Questions (Long Answers)

Unit I: Bryophytes

1. Describe in detail the classification of bryophytes by Smith (1955).
2. Explain the reproduction in Marchantia.
3. Describe the reproductive structures of Funaria.
4. Discuss the economic and ecological importance of bryophytes.

Unit II: Pteridophytes

5. Compare the thallus structure and reproduction in Equisetum and Marsilea.
6. Describe the morphology of Equisetum.
7. Describe the reproduction in Equisetum.
8. Describe the morphology of Marsilea.
9. Describe reproduction in Marsilea.
10. Explain various types of stele with suitable diagrams.
11. Describe heterospory and its role in the evolution of seed habit.
12. Explain the economic importance and ornamental value of pteridophytes.

Unit III: Gymnosperms

10. Explain the reproductive structures of Pinus
11. Explain the reproductive structures of Gnetum.

Unit IV: Paleobotany

14. Describe the geological time scale and types of fossils.
15. Write detailed notes on Rhynia and Lyginopteris as fossil plants.
16. Describe the affinities of bryophytes with pteridophytes.
17. Discuss the evolutionary links between pteridophytes and gymnosperms, and gymnosperms with angiosperms.

Assessment Rubric: Internal for Theory Course (Major/Minor)

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)			
Theory	Course Code: _____	Course Title: _____	Max Marks: 20

S. No.	Assessment Criteria	Marks
1	Attendance in Theory Classes	5
2	Any One of the Activities suggested in Course (CAT-1)	5
3	Participation in Field Activity/ Visit (CAT-2)	5
4	Quiz/ MCQ Tests/Seminar/ Unit Test etc. based Theory Course (CAT-3)	5

Major Practical – 8: Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms	2	60	4 Hrs	25(Ext) + 25(Int)

Course Objectives:

- To Understand basic microbiological techniques including smear preparation, staining, and microbial observations.
- To enable students to identify algal, fungal, bryophytic, pteridophytic, and gymnosperm specimens through morphological and anatomical features.
- To impart skills for algal culturing and microbial isolation from natural habitats.
- To help students understand the ecological and reproductive aspects of lower plant groups.
- To promote observational, analytical, and documentation skills through practical exposure.

Course Outcomes:

- Explain and demonstrate structural features of microorganisms such as viruses, bacteria, and fungi.
- Gain practical skills in slide preparation, staining, and microbial identification.
- Capable of isolating and culturing microorganisms using standard microbiological techniques.
- Identify common algal and fungal species microscopically using temporary slides.
- Understand algal culturing techniques and microbial population analysis methods such as plate count and turbidity.
- Demonstrate knowledge of the anatomical and reproductive structures of bryophytes, pteridophytes, and gymnosperms.
- Develop skills in collecting rhizosphere fungi and applying ecological sampling methods.

List of Exercises:

1. Preparation of Temporary Slides and Identification of Algal Forms –

   (Nostoc, Volvox, Oedogonium, Chara, Vaucheria, Ectocarpus, Batrachospermum, Sargassum – Any Three)

2. Preparation of Temporary Slides and Identification of Fungal Forms

   (*Mucor, Rhizopus, Aspergillus, Puccinia, Albugo, Agaricus, Alternaria, Cercospora* – Any Three)

3. Study of Thallus Structure, Anatomy and Reproductive Features of Bryophytes

   (*Marchantia, Anthoceros, Funaria, Polytrichum* – Any Two)

4. Study of Thallus Structure, Anatomy and Reproductive Features of Pteridophytes

   (*Psilotum, Selaginella, Lycopodium, Marsilea, Equisetum* – Any Two)

5. Study of Plant Botany, Anatomy of Leaf/Stem and Reproductive Features of Gymnosperms

   (*Pinus, Taxus, Araucaria, Zamia, Gnetum* – Any two)

Activities (Any 4 of the following) -

1. Demonstration of Viral Structure
2. Preparation of a Bacterial Smear
3. Differentiation of Gram-Positive and Gram-Negative Bacteria
4. Identification of the Algal / Fungal Forms from the mixtures
5. Evolution of the Thallus in Algae / Bryophytes
6. Collect different types of gymnosperm cones, describe and identify the given gymnosperm material.

Any one activity of the following -

a. Botanical Excursion and report submission
b. Collection and identification of algal forms from local sites- report submission
c. Collection of fungal/ bacterial/ viral diseased plant specimens/ photographs and identification- report submission

Bibliography

Reference / Text Books / Research Articles

1. Sharma, O.P. – *Microbiology and Phycology*, McGraw Hill Education
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. – *Introductory Mycology*, Wiley
3. Kumar, H.D. – *Introductory Phycology*, Affiliated East-West Press
4. Parihar, N.S. – *Bryophyta*, Central Book Depot
5. Puri, P. – *Bryophytes and Pteridophytes*, Atma Ram & Sons
6. Sporne, K.R. – *The Morphology of Pteridophytes*, B.I. Publications
7. Chamberlain, C.J. – *Gymnosperms: Structure and Evolution*, Dover Publications
8. Relevant Research Articles from journals like *Journal of Applied Phycology*, *Mycologia*, *Indian Journal of Microbiology*, etc.

E-Contents / E-Books (Free or Purchase Links)

9. NCERT Biology Textbooks – Free official e-books
10. NPTEL Courses – Botany/Microbiology – Free video lectures and content
11. Botany eBooks Library (Internet Archive) – Historic and modern books
12. *Introductory Phycology* by Kumar HD – Available on Amazon/Flipkart
13. *Microbiology: An Introduction* by Tortora et al. – Pearson (purchase)

Digital Resources / Web Links

14. Botany Digital Herbarium – BSI
15. Microbiology Society – Resources & Journals
16. AlgaeBase – World-wide Electronic Publication
17. Fungal Biodiversity Centre – CBS
18. Khan Academy – Microbiology and Plant Biology
19. eFloras – Flora of India & other regions

Educational Software, Databases, etc.

20. Virtual Labs – Amrita Vishwa Vidyapeetham (MHRD, Govt. of India) Website: https://vlab.amrita.edu
21. PhycoBank (Algae Database)Website: https://www.phycobank.org
22. MycoBank (Fungal Names Database)
23. Website: https://www.mycobank.org
24. Official fungal nomenclature and taxonomy database with literature links.

25. The Plant List / World Flora Online Website: http://www.theplantlist.org, http://www.worldfloraonline.org
26. Botanical Survey of India – Digital Flora and HerbariumWebsite: https://bsi.gov.in
27. Zotero *(Research Reference Manager)*
28. Website: https://www.zotero.org
29. ImageJ – Biological Image Analysis SoftwareWebsite: https://imagej.nih.gov/ij
30. iNaturalist
31. Website: https://www.inaturalist.org
32. Flora of India Mobile App *(by BSI)*

Google Lens / PlantNet App

Assessment Rubric: External Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)				
Practical-8	Course Code: 107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms	Max Marks: 25	Time: 4 Hrs.

Q.No.	Exercise	Marks
1.	Preparation of Temporary Slides and Identification of Algal Forms (Any one)	4
2.	Preparation of Temporary Slides and Identification of Fungal Forms (Any one)	4
3.	Identification of Bryophyte (Any one)	4
4.	Identification of Pteridophyte (Any one)	4
5.	Identification of Gymnosperm (Any one)	4
5.	External Viva Voce	5

Assessment Rubric: Internal Practical Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)			
Practical-8	Course Code: 107214	Techniques in Microbial Studies, Plant Diseases and Cryptogams and Gymnosperms	Max Marks: 25

S. No.	Assessment Criteria	Marks
1	Record/ Assignments	5
2	Attendance	5
3	Participation in Activity/ Field visit	5
4	Students' overall performance	5
5	Internal Viva Voce	5

IKS –Major Specific: Sacred Plant Heritage of Maharashtra

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107215	Sacred Plant Heritage of Maharashtra	2	30	2 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To provide opportunities for understanding the history of sacred plants, traditional festivals and rituals in Maharashtra and connecting them to ancient beliefs, rituals and practices.
- To improve critical thinking and problem-solving skills through the study of traditional conservation strategies of sacred groves.
- To create awareness of conservation of sacred plants.
- To encourage students to apply their knowledge in ecological, ethnobotanical and conservational contexts.

Course Outcomes:

After completing this course, the students will be able to:

- Explain the scope and importance of Traditional knowledge of sacred plants in India.
- Understand the importance and role of traditional festivals, rituals and cultures.
- Compare the traditional conservation strategies of sacred plants with today's modern approaches.
- Reviling the potential of sacred plants in modern medicine.
- Utilize this knowledge in future medicinal research.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
I	**Introduction to Plant Heritage**	8	8	Suitable pedagogical strategies are separately annexed
	1.1 Holistic system of health and herbal remedies in Charak Sanhita, Sushruta Sanhita and Ashtang Hridaya			
	1.2 Herbal wealth in Ancient Indian Scriptures (Vedas, Upanishads and Puranas, Quaran, Guru Granth Sahib, Kalpa Sutra, Jataka Tales, etc.)			
	1.3 Ancient practices in Agriculture (Vrikshayurveda by Surapal and Krishi Parashara by Parashara)			
	1.4 Socio-cultural and religious significance of plants and their Parts			
II	**Sacred Plant Heritage:**	7	7	
	2.1 Prithivi Sukta from Atharvaveda for ecological consciousness			
	2.2 Sacred Trees, their cultural and religious values and Significance			
	2.3 Role of plants in rituals, festivals and customs as food, ornaments, preparation etc.			
	2.4 Regional Sacred and Spiritual Plants with Holistic Approach – Durva (दूर्वा), Tulsi (तूळस), Shami (शमी), Banana (केळी), Palas (पळस), Peepal (पिंपळ), Banyan Tree (वड), Bel (बेल), Umber (ऊंबर),			

	Neem (कडू निम), Amala (आवळा), Jamun (जांभूळ), Coconut (नारळ), Mango (आंबा)			
III	Sacred Groves and Plant Conservation	8	8	
	3.1 Sacred Groves (देवराई): Role in Biodiversity and Ecological Conservation			
	3.2 Rules and Taboos for its protections			
	3.3 Heritage symbols: National and Maharashtra State Plant Symbols (Tree/Flower/Fruit/Medicinal Plant, etc.)			
	3.4 Integration of plants from traditional knowledge in AYUSH			
IV	Application and Modern Aspects	7	7	
	4.1 Scientific Temperament for Folk Beliefs and Practices			
	4.2 Ethical Practices in Commercialization and Exploitations plant wealth			
	4.3 Relevance of Ancient Indian Knowledge in the present time			
	4.4 Emerging trends and future research needs to explore Indian Traditional Knowledge			

Suggested Activities:

1. Interactive Lecture & Discussion: Introduce students to ancient plant-based knowledge systems. Highlight Ayurveda, the classification of medicinal plants, and their traditional uses. Provide examples of modern applications, like how traditional knowledge influences pharmaceutical discoveries today.

2. Task: Create Your Plant Codex: Divide students into groups. Assign each group a region of India and ask them to research, indigenous plants and their uses. Ask each group to compile their findings into a visual representation like a chart, info-graphic or booklet. Also prepare the diagram or poster showing different plant families & their characteristics.

3. Creative Task: Ask students to write or perform a short skit embodying one plant's role in the scriptures. For example, dramatize the use of the Soma plant in rituals. Also create arts pieces using plant materials such as leaves, flowers or seeds.

4. Reflection Activity: Students write an essay on the integration of plant wisdom in ancient Indian spiritual practices.

5. Field Visit (if feasible): Take students to a nearby sacred grove or historical tree site. Discuss the traditions of tree worship, such as Kalpavriksha and its representation in Indian heritage. As well as collect plant specimens from sacred groves and identify them using keys/flora or other resources.

6. Organization of Workshop and Conferences: Invite a local historian or botanist to share insights on tree worship's significance through time. To bring together researchers, policymakers and industry stockholders to discuss the latest research & development in medicinal plants.

7. Group Project: Students collaborate to create a timeline showing the evolution of tree worship practices from the Indus Valley Civilization to modern India.

8. Hands-On Activity: Organize a ritual-recreation session where students enact and explain the cultural symbolism (e.g., Gudhi flags with mango/betel leaves or Tulsi's ritual during Diwali).

9. Cultural Essays: Students will interview locals or grandparents to collect oral histories/stories about plants. Compile these into a class journal of plant heritage.

10. Introduction Discussion: Begin with a short story or video about a sacred plant, like the Tulsi plant's role in Indian households. Discuss the concept of sacredness in nature and why certain plants are considered sacred across different cultures.

11. Debate Activity: Ancient Beliefs vs. Modern Science: Topic: "Are sacred trees revered more for their religious value or scientific/environmental benefits?" Divide the class into two teams to debate. Each side incorporates examples and findings from their research.
12. Storytelling Session: Share historical accounts or myths surrounding sacred groves, such as the connection between sacred groves and village deities, or the cultural beliefs in protecting groves as abodes of gods.
13. Field Visit (if possible): Organize a visit to a nearby sacred grove or biodiversity park or Devrai to observe: 1. Native plant species. 2. The untouched ecosystem.
14. Biodiversity Mapping: Students document the different plants, birds, and insects found in the grove (using pictures and notes). Research, how such biodiversity is crucial for the local and global environment (e.g., as seed banks, oxygen park).
15. Case Studies: Assign case studies on groves acting as natural refuges for endangered species. Students can research success stories where groves played an active role in ecological restoration. Also conduct a case study of specific sacred grove or plant, examining its history, cultural significance & conservation.
16. Experimental Workshop: Students perform simple experiments, such as testing the antimicrobial properties of Tulsi or Neem leaves to evaluate traditional claims.

References:
Reference Books, Text Books, Research Articles:

- Agarwal, P., & Kumar, V. (2021). Indian knowledge systems: Ancient wisdom in contemporary times. *Springer.*
- Aher, S. K., (2017). Study of Some Sacred Plants of Ahmednagar District, Maharashtra, India. International Journal of Current Research, pp- 59706-59709.
- Ahirwar H. K. and S. Mohabe (2022). Medicinal and Plants, Significance of Sacred Natural Sites, Raisen District of Madhya Pradesh, India. Journal of Medicinal Plants Studies, 10(3): 55-61.
- Azarpour, E., Moraditochaee, M., & Bozorgia, H. R. (2014). Study of medicinal plants in Holy Quran. *International Journal of Plant, Animal and Environmental Science, 4*(2), 529-536
- Badve S. B., (2018). Nakshatravan. Ujwal Prakashan, Sanwad Trade Prints, 595, Shaniwar Peth, Pune-411030.
- Banerjee, S., & Singh, R. (2020). The revival of Ayurveda: An integrative approach in modern medicine. *Journal of Traditional Medicine and Clinical Naturopathy, 9*(4), 78-89. https://doi.org/10.1080/01619440.2020.1784623
- Bhardwaj, R. K., & Choudhury, B. K. (2021). Vedic mathematics: An ancient tool for modern computational techniques. *International Journal of Mathematics and Computer Applications, 15*(2), 56-65.
- Bhatla N., T. Mukherjee and G. Singh (1984). Plants: Traditional Worshiping. Indian Journal of History of Science, 19(1): 37-42.
- Chakraborty, S., & Gupta, M. (2022). The role of traditional Indian farming practices in sustainable agriculture. *Journal of Sustainable Agriculture, 32*(1), 12-29. https://doi.org/10.1080/14620316.2022.2013800
- Das S. (2018-19). Sacred Plants of India: A Brief Review. M.U.C. Women's College, Department of Botany, Burdwan University, Burdwan.
- Dekhane, M. Myra Ani Devraiche Gupit Bhag 1, Dilipraj Prakashan Pvt. Ltd.
- Dekhane, M. Myra Ani Devraiche Gupit Bhag 2, Dilipraj Prakashan Pvt. Ltd.
- Gaykar Balasaheb, (2011). Sacred Groves: Traditional Way of Conserving Plant Diversity. Journal of Ecobiotechnology, 3(9): 23-25.
- Ghate V., Kore P. and R. Adkar, (2018). Sacred Groves in Satara District: Traditional Heritage under Threat. Research wing of Forest Department, Pune, Government of Maharashtra.

- Gupta S. M. (1968). Plant Myths and Traditions in India. Munshiram Manoharlal Publisher, ISBN 978812510073.
- Jagadeesh, A. Devarai Aakhyan, Prafullata Publication, Pune
- Juyal P. (2023). Ethnobotany, Uttarakhand Open University, Haldwani, Nainital, 263139.
- Kadam V. and S. Deosthale (2023). Documentation of Sacred Medicinal Plants from Painganga Forest Range, Umarkhed, Dist. Yavatmal, Maharashtra. International Journal for Multidisciplinary research, ICMRS-23: 1-3.
- Khare S. M. and S. B. Pawar, (2018). Ethnobotanical Studies of Some Sacred Plants of Jalgaon District, Maharashtra, India. International Journal of Botany Studies, Pratap College, Amalner, pp- 79-83.
- Khare S. M. and S. B. Pawar, (2018). Investigation on Sacred Plants in North Maharashtra: Diversity, Ethno Economics, Significance and Conservation. Kavayitri Bahinabai Chaudhari North Maharashtra University, Shodhganga@INFLIBNET, pp-45-57.
- Khare S. M., (2018). Investigation on Sacred Plants in North Maharashtra: Diversity, Ethno Economics, Significance and Conservation. Kavayitri Bahinabai Chaudhari North Maharashtra University, Shodhganga@INFLIBNET.
- Khare S. M., S. Pawar and D. A. Patil, (2020). Role of Exotics Sacred Plants in Bioculture of Khandesh region of Maharashtra. International Journal of Botany Studies, Pratap College Amalner, pp-293-299.
- Khare S. M., S. Pawar and D. A. Patil, (2021). Plants of Temples and Religious Places in Khandesh Region (Maharashtra): An Ethnobotanical Perspective. Plantae Scientia, 4(5): 257-265.
- Krishna N. and M. Amrithalingam (2014). Sacred Plants of India. Penguin Books India.
- Krishna N. and M. Amrithalingam (2015). Sacred Plants of India. Tattvaloka, 59-77.
- Krishna N., (2006). Ecological Traditions of Maharashtra. C.P.R. Environmental Education Centre. 1 Eldams Road, Alwarpet, Chennai – 600 018. Tamil Nadu, India.
- Kulkarni D. K., D. S. Nipunage, L. M. Hangarge and P. B. Kamble, (2010). Natural heritage of forest conservation in Bhor region of Pune, India. Asian Journal of Environmental Science, 5(2): 94-98.
- Kumar, A., & Saxena, S. (2019). *Medicinal Plants in Jain Literature: An Analytical Study*. *Journal of Indian Traditional Medicine*, 7(2), 123–130.
- Kumar, N., & Rao, K. (2021). Sacred groves and biodiversity conservation in India. *Ecology and Environment, 27*(2), 115-130. https://doi.org/10.1080/10509585.2021.1839786
- Kumar, R., & Singh, A. (2021). Traditional Indian environmental practices and their impact on contemporary environmental policies. *Environmental Policy and Practice, 33*(2), 123-136. https://doi.org/10.1080/01973322.2021.1875925
- Mohanty, A., & Singh, V. (2021). Integration of Ayurveda in modern healthcare: A review. *Journal of Integrative Medicine, 19*(2), 142-153. https://doi.org/10.1016/j.jom.2021.02.001
- Nadkarni, A. Devraichya Savalit, Prafullata Publication, Pune
- Pande D. and V. C. Pandey (2016). Sacred Plants from Ancient to Modern Era: Traditional Worshiping towards Plants Conservation. Tropical Plant Research: An International Journal, 3(1): 136-141.
- Pushpinder Jai Rup. (2024). *Sri Guru Granth Sahib Wich Paudian da Zikar*. Guru Nanak Dev University.

- Roy, K. (2011). Study of Jataka stories as a source of Indian history. *Indian Journal of Buddhist Studies, 22*(1), 45–60. Retrieved from https://www.academia.edu/23406061/STUDY_OF_JATAKA_STORIES_AS_A_SOURCE_OF_INDIAN_HISTORY
- Sheikh, D. K., & Dixit, A. K. (2015). Plants in the Holy Quran: A look. *World Journal of Pharmacy and Pharmaceutical Sciences, 4*(8), 715–738. https://www.researchgate.net/publication/281200399
- Singh A., S. Tiwari and P. Kavita (2023). Sacred Medicinal Plants of India. International Journal of Herbal Medicine, 11(1): 40-51.
- Singh, A., & Bhardwaj, A. K. (2024). Roots of wisdom: Exploring ancient Indian knowledge system in botany. *IEHE The Quest*, 3(1), 10-15.
- Sood S. K., V. Thakur and T. N. Lakhanpal, (2005). Sacred and Magico-Religious Plants of India. Scientific Publisher, ISBN- 9788172334141.
- Srivastava, R., & Patel, M. (2022). Interdisciplinary research in Indian knowledge systems: Bridging ancient wisdom with modern science. *Journal of Interdisciplinary Studies, 17*(3), 88-102. https://doi.org/10.1080/12345678.2022.2010374
- Tripathi, A., & Kumar, R. (2021). Ancient Indian texts and their relevance in contemporary research. *Studies in Humanities and Social Sciences, 29*(1), 56-71. https://doi.org/10.1016/j.shss.2021.03.004
- Varma, P., & Kapoor, A. (2022). Indian traditional knowledge and its integration in higher education: A policy perspective. *Higher Education Review, 35*(1), 45-59. https://doi.org/10.1080/09523987.2022.1883928
- Zade N. S., 2015. Some Sacred Tree and their Medicinal Uses from Amravati District (Maharashtra). International Journal of Science and Research, pp- 220-230.

1-Mark Questions (Answer in One Sentence)

Unit I: Introduction to Plant Heritage

1. Name any one Ayurvedic scripture that discusses herbal remedies.
2. Which scripture contains the concept of 'Vrikshayurveda'?
3. Mention one plant-related reference from the Vedas.
4. What is the main focus of Krishi Parashara?
5. State one socio-religious use of plants in Indian culture.

Unit II: Sacred Plant Heritage

6. What is Prithvi Sukta?
7. Name a sacred tree revered in Indian culture.
8. Which plant is commonly used in Indian festivals for making garlands?
9. Which tree is considered sacred and planted near temples?
10. Name one sacred plant used in rituals in Maharashtra.

Unit III: Sacred Groves and Plant Conservation

11. What are sacred groves called in Marathi?
12. State one role of sacred groves in biodiversity conservation.
13. Name the national tree of India.
14. Mention one rule or taboo followed in sacred groves.
15. Which system integrates traditional knowledge into health care in India?

Unit IV: Application and Modern Aspects

16. What is meant by scientific temperament?
17. Name one unethical practice in commercialization of plant wealth.
18. State one relevance of Indian plant heritage in today's world.
19. Mention one emerging trend in the study of Indian traditional plant knowledge.
20. What does AYUSH stand for?

3-Mark Questions (Short Answers)

Unit I: Introduction to Plant Heritage

1. Compare the herbal health approaches in Charak Sanhita and Sushruta Sanhita.
2. Describe any three references of herbal wealth from ancient scriptures.
3. Write a short note on Vrikshayurveda
4. Mention ancient Indian practices in agriculture.
5. Explain the religious use of any three plant parts in Indian tradition.

Unit II: Sacred Plant Heritage

6. Write about any three sacred trees and their cultural roles.
7. Describe the use of plants in Indian rituals and festivals.
8. Write a note on the spiritual value of Tulsi.
9. Write a note on the spiritual value of Bel.
10. Write a note on the spiritual value of Shami.
11. Explain the holistic approach behind the use of Banana
12. Explain the holistic approach behind the use of Neem and Mango in tradition
13. Explain the holistic approach behind the use of Mango in tradition
14. Describe holistic significance of regional sacred plant Tulsi.
15. Describe holistic significance of regional sacred plant Palas.
16. Describe holistic significance of regional sacred plant Bel.

Unit III: Sacred Groves and Plant Conservation

11. Describe any three ecological benefits of sacred groves.
12. Mention the rules and taboos that help preserve sacred groves.
13. Explain any three heritage plant symbols of India or Maharashtra.
14. Write a short note on the contribution of AYUSH in promoting traditional knowledge.
15. Describe the significance of Umber, Amala, and Jamun in ecological conservation.
16. Describe the significance of Amala, and Jamun in ecological conservation
17. Describe the significance of Umber and Jamun in ecological conservation

Unit IV: Application and Modern Aspects

16. How can scientific temperament help validate folk plant practices?
17. Write a short note on ethical vs unethical practices in plant commercialization.
18. Mention three modern applications of ancient Indian botanical knowledge.
19. Describe any three areas of research needed in traditional plant wisdom.
20. What role can education play in integrating traditional knowledge with modern science?

6-Mark Questions (Long Answers)

Unit I: Introduction to Plant Heritage

1. Explain the holistic systems of health and herbal treatment described in Charak, Sushruta, and Ashtang Hridaya.
2. Describe herbal references found in Vedas, Upanishads, Puranas, and other scriptures.
3. Discuss in detail the ancient agricultural practices mentioned in Vrikshayurveda and Krishi Parashara.
4. Write an essay on the religious and socio-cultural significance of plants in ancient India.

Unit II: Sacred Plant Heritage

5. Describe the ecological consciousness in the Prithvi Sukta from Atharvaveda.
6. Write detailed notes on sacred trees and their religious values in Indian tradition.
7. Explain the role of plants in rituals, festivals, and customs with examples.
8. Elaborate on the holistic significance of regional sacred plants Palas, Bel and Neem.
9. Elaborate on the holistic significance of regional sacred plants Tulsi, Peepal, and Palas,

Unit III: Sacred Groves and Plant Conservation

9. Describe the role of sacred groves (Devarai) in biodiversity and ecological conservation.
10. Explain the cultural taboos and traditional rules associated with sacred groves.

11. Discuss the heritage plant symbols of India and Maharashtra with their significance.
12. Describe how traditional knowledge systems have been integrated into AYUSH and plant-based healthcare.

Unit IV: Application and Modern Aspects

13. Discuss the importance of developing scientific temperament to understand traditional plant practices.
14. Elaborate on ethical concerns in commercialization and exploitation of plant wealth.
15. Explain the relevance of ancient Indian botanical knowledge in the current era.

Assessment Rubric: Internal for IKS (Major Specific) Course

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)			
Theory	Course Code: 107215	Course Title: Sacred Plant Heritage of Maharashtra	Max Marks: 20

S. No.	Assessment Criteria	Marks
1	Attendance in Theory Classes	5
2	Any One of the Activities suggested in Course (CAT-1)	5
3	Participation in Field Activity/ Visit (CAT-2)	5
4	Quiz/ MCQ Tests/Seminar/ Unit Test etc. based Theory Course (CAT-3)	5

Minor Theory: Plant Diversity, Conservation & Forensic Botany

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107216	Plant Diversity, Conservation & Forensic Botany	2	30	2 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To recall the fundamental characteristics of microbes, cryptogams, and phanerogams.
- To understand the role of symbiotic associations like Mycorrhiza and Lichens in nature.
- To comprehend the importance of plant conservation methods and biodiversity.
- To apply the knowledge of microbes and plant diversity in agriculture, pharmaceuticals, and reclamation.
- To use forensic botany knowledge for collecting and analyzing phyto-evidence.
- To analyze the causes of plant extinction and loss of biodiversity.
- To distinguish between Gymnosperms and Angiosperms based on reproductive and morphological features.
- To evaluate the importance of phyto-evidence like pollen, seeds, and fibers in forensic investigations.
- To design conservation models for biodiversity protection and resource utilization.
- To develop case studies using DNA fingerprinting and forensic botany techniques.

Course Outcomes:

After completing this course, the students will be able to:

- Explain the general features of Bacteria, Cyanobacteria, Viruses, Fungi, Algae, Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms.
- Summarize the concept of biodiversity, extinction, and conservation methods like Ex-situ and In-situ conservation.
- Understand the role of Mycorrhiza and Lichens in promoting plant growth and maintaining ecological balance. Demonstrate the application of microbes and plants in industries like agriculture, medicine, and environmental conservation.
- Apply techniques of forensic botany to identify and assess plant-based evidence in criminal investigations. Evaluate the role of phyto-evidence (pollen, fibers, seeds, leaves) in solving criminal cases.
- Analyze the causes and impact of biodiversity loss and propose conservation measures.
- Assess the economic and ethnobotanical significance of plants like Wheat, Rice, Cotton, and medicinal plants.
- Create and design conservation strategies for biodiversity preservation using in-situ and ex-situ conservation models.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
I	**Microbial and Cryptogamic Diversity**	8	8	Suitable pedagogical strategies are separately annexed
	1.1 Microbial Diversity: General Characteristics features of microbe (Bacteria, Cyanobacteria, Viruses, Fungi, Algae)			
	1.2 Symbiotic Association: Mycorrhiza and Lichens			
	1.3 Bryophytes & Pteridophytes: General Characteristics features and Economic Importance			
	1.4 Microbes at Service of Mankind: Resource Exploitation and utilization			

	(Agriculture, Pharmaceutical, Fertilizer, Reclamation)			
II	**Phanerogams Diversity**	7	7	
	2.1 Gymnosperm: General Character, Reproductive Structure (*Pinus, Cycas*), Economic Importance			
	2.2 Angiosperms: Structural / Morphological Diversity in Monocot and Dicot			
	2.3 Reproduction in Angiosperm: Types of Pollination, Seed dispersal			
	2.4 Economic and Ethnobotanical Plant: Economically significant Plant (wheat, cotton, sugarcane), Important Plant in Traditional Medicine System in Brief Tulsi and Adulsa			
III	**Plant Conservation**	8	8	
	3.1 Biodiversity: Concept and Significance			
	3.2 Extinction of Plants: Causes, Overview / Introduction to Red Data Book			
	3.3 Ex-situ and In-Situ Conservation: Concept and Scope, Seed Bank			
	3.4 Case Study: Conservation of *Gloriosa superba* - An example of science-policy-community synergy in Maharashtra			
IV	**Forensic Botany**	7	7	
	1.1 Forensic Botany: Scope, Concept and Limitations			
	1.2 Phyto -evidences and Offences: Pollen, Seeds, Fibres and leaves as phyto-evidences in offences and Importance			
	1.3 Application of Phyto -evidences: identification, Collection, Assessment in forensic Investigation			
	1.4 DNA fingerprinting: Techniques for phyto-evidences identification, Case Study			

1-Mark Questions (One-Sentence Answers)

Unit I: Microbial and Cryptogamic Diversity

1. Name any one characteristic of bacteria.
2. What is a mycorrhiza?
3. Write one use of cyanobacteria.
4. Name one economic use of pteridophytes.
5. Give one example of a symbiotic association in plants.

Unit II: Phanerogams Diversity

6. Name a gymnosperm with a well-defined cone.
7. What is the difference between monocot and dicot leaves? (any one)
8. Name any one pollinating agent.
9. Mention one seed dispersal mechanism.
10. Give the scientific name of Tulsi.

Unit III: Plant Conservation

11. What is biodiversity?
12. Name any one cause of plant extinction.
13. What is a seed bank?

14. Give one example of an ex-situ conservation site.
15. What is the full form of IUCN?

Unit IV: Forensic Botany

16. Define forensic botany
17. Mention one plant part used as phyto-evidence.
18. What is the use of DNA fingerprinting in forensic botany?
19. Name any one limitation of forensic botany.
20. Give an example of a forensic case solved using plant DNA.

3-Mark Questions (Short Answers)

Unit I: Microbial and Cryptogamic Diversity

1. Write general features of viruses.
2. Write general features of bacteria.
3. Write general features of fungi.
4. Describe mycorrhiza.
5. Describe lichen.
6. List the economic uses of bryophytes
7. List the economic uses of pteridophytes.

Unit II: Phanerogams Diversity

6. Describe general characters of Cycas.
7. Describe general characters of Pinus.
8. Describe reproductive structures in Cycas.
9. Describe reproductive structures Pinus.
10. Differentiate between monocot and dicot .
11. Explain the types of pollination with examples.
12. Write a note on seed dispersal by wind and animals.
13. Explain the medicinal importance of Adulsa.
14. Explain the medicinal importance of Tulsi.

Unit III: Plant Conservation

11. Explain importance of Biodiversity .
12. Describe causes of plant extinction
13. Explain ex-situ conservation .
14. Write a note on botanical gardens and their role.
15. Explain the concept of sacred groves with examples.

Unit IV: Forensic Botany

16. Explain scope of forensic botany.
17. Describe the role of pollen and fibres in criminal investigation.
18. How are seeds and leaves used as phyto-evidence?
19. Explain the procedure of collecting plant evidence at a crime scene.
20. Describe any technique used in DNA fingerprinting of plant samples.

6-Mark Questions (Long Answers)

Unit I: Microbial and Cryptogamic Diversity

1. Describe the general characteristics and significance of microbes: cyanobacteria.
2. Explain symbiotic associations: structure, types, and ecological importance of mycorrhiza.
3. Describe the characteristics feature and economic importance of bryophytes.
4. Describe the characteristics feature and economic importance of pteridophytes.

Unit II: Phanerogams Diversity

5. Discuss the general characters, reproductive structures of Cycas.
6. Discuss the general characters, reproductive structures of Pinus.
7. Compare the morphological features of monocot and dicot plants with suitable examples.
8. Explain the process of pollination, pollinating agents, and types of seed dispersal with examples.
9. Describe the economic importance of wheat and rice.
10. Describe the economic importance of cotton, and sugarcane.
11. Describe ethnobotanical uses of Tulsi and Adulsa.

Unit III: Plant Conservation

9. Define biodiversity and explain its significance in the ecosystem.
10. Explain the concepts, methods, and advantages of ex-situ conservation including seed banks.
11. Discuss in-situ conservation methods with examples of national parks, wildlife sanctuaries, botanical gardens, and sacred groves.

Unit IV: Forensic Botany

13. Explain the concept, scope, and limitations of forensic botany in crime investigation.
14. Discuss the use of phyto-evidences like pollen, seeds, fibres, and leaves in solving crimes.
15. Describe the collection, preservation, and role of phyto-evidence in forensic investigations.
16. Elaborate on DNA fingerprinting techniques and present a case study involving plant evidence.

Minor Practical – 9: Practical Approach towards Plant Diversity, Conservation and Forensic Botany

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany	2	60	4 Hrs	25 (Ext) +25 (Int)

Course Objectives:

- Identify the general characteristics and economic importance of microbes, bryophytes, pteridophytes, and gymnosperms.
- Explain the role of microbes in agriculture, pharmaceuticals, and environmental reclamation.
- Describe the reproductive structures of angiosperms and gymnosperms with respect to their morphological diversity.
- Apply knowledge of traditional and ethnobotanical plants in health care and economic development.
- Use forensic botany techniques to collect, analyze, and interpret phyto-evidence from crime scenes.
- Analyze plant conservation methods through in-situ and ex-situ approaches.
- Differentiate between different types of pollination and their ecological significance.
- Design herbarium, plant charts, and infographics on plant diversity, economic plants, and traditional medicine practices.

Course Outcomes:

- Identify and classify different groups of microbes, cryptogams, and phanerogams based on their characteristics.
- Explain the reproductive structures, pollination mechanisms, and seed dispersal methods in angiosperms and gymnosperms.
- Apply practical knowledge in microbial culture, herbarium preparation, natural dye extraction, and forensic evidence collection.
- Analyze the economic importance of plants in traditional medicine, agriculture, and industry.
- Evaluate the role of conservation methods in biodiversity protection and sustainable utilization of plant resources.

Major Experiments (Perform any 6)

1. Preparation and observation of slides of algal material
2. Study of Gram staining techniques.
3. Preparation and observation of slides of fungal material
4. Study of the morphological and reproductive structures of Bryophytes
5. Study of the morphological and reproductive structures of Pteridophytes
6. Study of the morphological and reproductive structures of Gymnosperms
7. Comparative analysis of Monocot vs. Dicot Angiosperms.
8. Study of the structure of the flower in Monocot and Dicot
9. Study of Pollen Grain structure under microscope
10. To study the morphology and uses of ethnobotanical plants (Any one).

Minor Experiments (Perform any 4):

1. Simple staining of plant cells and observation under a microscope.
2. Identification of different types of lichens and their environmental significance.
3. Preparation of Herbarium of any five local plant specimen.
4. Identification of common natural fibres (cotton, jute) under a microscope.
5. Study of the standard techniques for handling soil samples
6. Preparation of the media for microbial culture.

7. Extraction of natural dyes from leaves, flowers, and bark.
8. Demonstration of Agarose gel electrophoresis.

Activities (Perform any Two):

1. Observation and recording of various pollination mechanisms in angiosperms.
2. Collection, preservation, and microscopic analysis of seeds and plant fragments from mock crime scenes.
3. Visit of the National Park, Wildlife sanctuaries, Botanical Garden and Sacred grooves

Bibliography:

Reference Books

1. Alexopoulos, C. J., Mims, C. W., & Blackwell, M. (1996). Introductory Mycology (4th ed.). New York: John Wiley & Sons.
2. Smith, G. M. (1955). Cryptogamic Botany: Algae and Fungi (Vol. 1). New York: McGraw-Hill.
3. Mehrotra, R. S., & Aggarwal, A. (2009). Plant Pathology (2nd ed.). New Delhi: Tata McGraw Hill.
4. Singh, P. (2016). Bryophyte and Pteridophyte: Morphology, Structure, and Reproduction. New Delhi: Rastogi Publications.
5. Sharma, O. P. (2009). Textbook of Algae. New Delhi: Tata McGraw-Hill Education.
6. Pandey, S. N., & Misra, S. P. (2008). Taxonomy of Angiosperms. New Delhi: Ane Books Pvt. Ltd.

Text Books

1. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (1993). Microbiology (5th ed.). New York: McGraw-Hill Inc.
2. Kumar, H. D., & Singh, H. N. (2005). Algae: Taxonomy, Structure, and Reproduction. New Delhi: Eastern Book Corporation.
3. Vashishta, B. R., Sinha, A. K., & Kumar, A. (2017). Botany for Degree Students- Bryophyta. New Delhi: S. Chand & Company Pvt. Ltd.
4. Vashishta, P. C. (2017). Gymnosperms. New Delhi: S. Chand & Company Pvt. Ltd.
5. Singh, V., Pande, P. C., & Jain, D. K. (2010). Taxonomy of Angiosperms. New Delhi: Rastogi Publications.
6. Moore, R., Clark, W. D., & Stern, K. R. (1995). Botany (5th ed.). New York: Wm. C. Brown Publishers.

Research Articles

1. Glick, B. R., & Pasternak, J. J. (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Journal of Applied Microbiology, 94(3), 367-375. https://doi.org/10.1046/j.1365-2672.2003.01900.x
2. Hegde, N. G., & Upadhyay, A. (2019). Role of Mycorrhiza in Sustainable Agriculture. *International Journal of Plant Sciences*, 14(2), 256-262. https://doi.org/10.1007/s10304-019-0304-6
3. Prakash, S., & Prasad, M. N. V. (2020). Ethnobotanical Plants and Their Uses in India: A Critical Review. *Journal of Medicinal Plants Research*, 14(3), 154-162. https://doi.org/10.5897/JMPR.20.032
4. Rao, P. S., & Kumar, S. (2021). Diversity of Medicinal Plants in Sacred Groves of Western Ghats. *Biodiversity and Conservation*, 30(5), 1201-1215. https://doi.org/10.1007/s10531-021-02145-8

Online References

1. National Center for Biotechnology Information (NCBI). (2024). Microbial Culture Techniques. https://www.ncbi.nlm.nih.gov
2. Botanic Gardens Conservation International (BGCI). (2024). Plant Biodiversity and Conservation. https://www.bgci.org
3. World Health Organization (WHO). (2024). Traditional and Herbal Medicine. https://www.who.int
4. Indian Biodiversity Portal. (2024). Sacred Groves and Traditional Ecological Knowledge. https://www.indianbiodiversity.org
5. National Institute of Plant Genome Research (NIPGR). (2024). DNA Fingerprinting in Plants. https://www.nipgr.ac.in

Question Paper for Minor External Practical Course on Practical Approach towards Plant Diversity, Conservation and Forensic Botany

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP-2020)				
Practical-9	Course Code: 107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany	Max Marks: 25	Time: 4 Hrs.

Q.No.	Exercise	Marks
1.	Perform Any One Major Experiment	10
2.	Perform any One Exercise from Minor Experiments	5
3.	Spotting (Five Spots carrying 01 March from the entire curriculum)	5
4.	External Viva Voce	5

Assessment Rubric for Internal Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP) Minor			
Practical-9	Course Code: 107217	Practical Approach towards Plant Diversity, Conservation and Forensic Botany	Max Marks: 25

S. No.	Assessment Criteria	Marks
1	Record/ Assignments	5
2	Attendance	5
3	Participation in Field Activity/Visit	5
4	Students overall performance	5
5	Internal Viva Voce	5

GOEC Theory: Traditional Health Care

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107218	Traditional Health Care	2	30	2 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To provide opportunities for understanding the history of Traditional Health care system.
- To know about Traditional health practices.
- To learn how to use ethnographic techniques to understand the socio-cultural context of traditional health practices.
- To create awareness of conservation of medicinal plants.

Course Outcomes:

After completing this course, the students will be able to:

- Identify India's major systems of traditional health and trace their historical and theoretical roots.
- Explain the scope and importance of Traditional knowledge of plants in India.
- Understand how traditional medicine can be used to improve health and well-being.
- Apply the methods of observation, note-taking and interviewing in the completion of an ethically sound short field study project.
- Utilize this knowledge in future medicinal research.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
I	**Introduction, Historical Background and Perspective of Traditional Healthcare (THS)**	8	8	Suitable pedagogical strategies are separately annexed
	1.1 History and Evolution of Traditional Healthcare System in India.			
	1.2 Concept and Scope of Traditional Health care			
	1.3 Indian System of Medicine (ISM)			
	1.4 Perspective and Policies in health care development.			
II	**Role of plants and modern application in Traditional Healthcare system (THS)**	7	7	
	2.1 Plant as a source of Medicines.			
	2.2 Identification and characterization of medicinal plants - any two from *Withania somnifera* (Ashwagandha), *Gloriosa superba* (Kalihari / Flame Lily), *Terminalia arjuna* (Arjuna), *Gymnema sylvestre* (Gudmar), *Tinospora cordifolia* (Giloy)			
	2.3 Role of Traditional Healthcare in Modern Society and Global Health.			
	2.4 Challenges and opportunities in implementation of traditional and modern health care.			
III	**Plant based Traditional Healthcare and therapies**	8	8	
	3.1 Internal Medicines (Decoction, Infusion, Tinctures, Powder).			

	3.2 External Medicines (Topical application, Baths and soaks, Compresses).			
	3.3 Dietary Practices (Herbal teas, Medicinal plant-based food).			
	3.4 Therapies (Aroma therapy, Herbalism, Phytotherapy).			
IV	**Ethics and Traditional Medicine of THC**	7	7	
	4.1 Ethics in use of Traditional Medicine.			
	4.2 Clinical trials and outcome measures for THC.			
	4.3 Need of documentation and validation of THC knowledge.			
	4.4 Voluntary Certification of Traditional Health Practitioner			

Suggested Activities:

- **Interactive Lecture & Discussion:** Introduce students to history plant-based knowledge systems.
- **Task: Create Your Plant chart:** Divide students into groups. Assign each group a region of India and ask them to research, medicinal plants and their characterization. Ask each group to compile their findings into a visual representation like a chart, info-graphic or booklet. Also prepare the diagram or poster showing different medicinal plant & their characteristics.
- **Essay Activity:** Organize write an essay competition on the Global Health Awareness Day on the topic **the recent developments in the public health care system.**
- **Field Visit:** Through visits to and interaction with organizations and individuals working in India's traditional healthcare system, students gain first-hand exposure to the practices and environments of these alternative systems of wellness.
- **Visit to Naturopathy Hospitals and clinics:** Visit to Ayurveda, Naturopathy hospitals, clinics, and ashrams to observe traditional health practitioners.
- **Organize Workshops, Health Awareness Talk**: Attend or organize workshops to learn about traditional medicines, raise awareness about health, nutrition, and early disease identification.
- **Group Project:** Students collaborate to create a timeline showing the evolution of tree worship practices from the Indus Valley Civilization to modern India.
- **Hands-On Activity:** Collection of Data: Homemade remedies and practices (Decoction, Kadhas) for health care suggested by Grannies medicine pouch.
- **Game-based learning activity:** Engaging traditional health care terminology games to boost students motivation.
- **Interview with Traditional doctor/vaidu (local)-** Through discussion students learn about the traditional treatment methods, plant and plant part used formulations of herbal drugs used by Traditional Healers (Vaidu).
- **Case Studies and Real-life Application:** Assign case studies on groves acting as natural refuges for endangered species. Also conduct a case study of specific plant, examining its history, cultural significance & conservation.

References:

Reference Books, Text Books, Research Articles:

- Agarwal, P., & Kumar, V. (2021). Indian knowledge systems: Ancient wisdom in contemporary times. *Springer.*
- Amit Jha: (2011) Traditional Indian Medicine.
- Amritpal Singh. (2019). A Textbook of Traditional Medicine.
- Hoffmaster, K. (2016). Traditional medicine: Old methods for the new you. [Kindle edition]. https://www.amazon.com/dp/B01MSCMUBB
- Saiket Sen, Raja Chakraborty. (2020). Herbal Medicine in India -Indigenous Knowledge, Innovation & its value
- Swapan Kumar Kolay, (2016)Ethno-Medicine for Traditional Health Care.

- Vijay Kumar Srivastava & Dr Anubha Srivastava. (2019). Hand Book on Marma and Panchakarma Therapy
- Gupta, S. M. (1968). Plant myths and traditions in India. Munshiram Manoharlal Publishers.
- Juyal, P. (2023). Ethnobotany. Uttarakhand Open University.

Research Articles

- **Bodeker, G.** (1994). Traditional health knowledge and public policy. *Nature and Resources*, 30(2), 5–16.UNESCO
- **Banerjee, S., & Singh, R.** (2020). The revival of Ayurveda: An integrative approach in modern medicine. *Journal of Traditional Medicine and Clinical Naturopathy*, 9(4), 78–89. https://doi.org/10.1080/01619440.2020.1784623
- **Houghton, P. J.** (1995). The role of plants in traditional medicine and current therapy. *Journal of Alternative and Complementary Medicine*, 1, 131–143. https://doi.org/10.1089/acm.1995.1.131
- **Katoch, D., Sharma, J. S., Banerjee, S., Biswas, R., Das, B., Goswami, D., Harwansh, R. K., Katiyar, C. K., & Mukherjee, P. K.** (2016). Government policies and initiatives for development of Ayurveda. *Journal of Ethnopharmacology*, 197, 25–31. https://doi.org/10.1016/j.jep.2016.08.018ResearchGate+1PubMed+1
- **Mohanty, A., & Singh, V.** (2021). Integration of Ayurveda in modern healthcare: A review. *Journal of Integrative Medicine*, 19(2), 142–153. https://doi.org/10.1016/j.joim.2021.02.001
- **Sheikh, D. K., & Dixit, A. K.** (2015). Plants in the Holy Quran: A look. *World Journal of Pharmacy and Pharmaceutical Sciences*, 4(8), 715–738. https://www.researchgate.net/publication/281200399
- **Kheirkhah, A. H., Kavianpour, M., & Ababzadeh, S.** (2024). Herbal medicine: A potent booster for stem cell therapy in cardiovascular diseases. *Advances in Traditional Medicine*.

Online References:

1. https://www.ncbi.nlm.nih.gov/books/NBK316267/
2. www.iosrjournals.org
3. www.ijsr.net
4. www.mail.journalcra.com
5. www.shodhganga.inflibnet.ac.in
6. www.researchjournal.co.in

1-Mark Questions (One-Sentence Answers)

Unit I: Introduction, Historical Background and Perspective of THS

1. What is traditional healthcare? / पारंपरिक आरोग्य सेवा म्हणजे काय?
2. Name any two ancient medical texts of India. / भारतातील प्राचीन वैद्यकीय ग्रंथांची नावे लिहा.
3. What is ISM? / ISM म्हणजे काय?
4. Name one major contributor to Ayurvedic literature. / आयुर्वेद साहित्याचा एक प्रमुख योगदानकर्ता कोण?
5. What is the scope of traditional healthcare? / पारंपरिक आरोग्य सेवांचा काय व्याप्ती आहे?
6. Mention one policy related to healthcare development. / आरोग्यविकासाशी संबंधित एक धोरण नमूद करा.
7. Define holistic healthcare. / समग्र आरोग्यसेवा याची व्याख्या करा.

Unit II: Role of Plants and Modern Application in THS

1. Name any two medicinal plants. / कोणत्याही दोन औषधी वनस्पतींची नावे लिहा.
2. What is the source of most traditional medicines? / बहुतेक पारंपरिक औषधांचा स्रोत काय आहे?
3. What is pharmacognosy? / वनौषधीशास्त्र म्हणजे काय?
4. Name one modern use of herbal medicine. / वनस्पती औषधाचा एक आधुनिक उपयोग सांगा.
5. Give one example of plant-based pharmaceutical. / वनस्पती आधारित औषधाचा एक उदाहरण द्या.
6. What is global health? / जागतिक आरोग्य म्हणजे काय?
7. Name any one challenge in traditional medicine. / पारंपरिक औषधशास्त्रातील एक आव्हान सांगा.

Unit III: Plant-Based Traditional Healthcare and Therapies

1. What is decoction? / क्वाथ म्हणजे काय?
2. Name any one external traditional remedy. / पारंपरिक बाह्य उपायांपैकी एकाचे नाव सांगा.
3. What is herbal infusion? / वनस्पती अर्क म्हणजे काय?

4. What is aromatherapy? / सुगंधोपचार म्हणजे काय?
5. What is phytotherapy? / वनस्पती चिकित्साशास्त्र म्हणजे काय?
6. Name one dietary practice used traditionally. / पारंपरिक आहार पद्धतींचे एक उदाहरण सांगा.
7. Define tincture. / टिंचर म्हणजे काय?

Unit IV: Ethics and Traditional Medicine of THC

1. What is meant by ethical use of traditional medicine? / पारंपरिक औषधांचा नैतिक वापर म्हणजे काय?
2. What are clinical trials? / नैदानिक चाचण्या म्हणजे काय?
3. Define validation of knowledge. / ज्ञानाचे प्रमाणीकरण म्हणजे काय?
4. What is documentation? / दस्तऐवजीकरण म्हणजे काय?
5. What is voluntary certification? / ऐच्छिक प्रमाणपत्र म्हणजे काय?
6. Name one ethical issue in traditional healthcare. / पारंपरिक आरोग्य सेवांमधील एक नैतिक मुद्दा सांगा.
7. What is outcome measure? / परिणाम मापन म्हणजे काय?

3-Mark Questions (Short Answers)

Unit I

1. Write a short note on the historical background of traditional healthcare in India. / भारतातील पारंपरिक आरोग्यसेवेचा ऐतिहासिक पार्श्वभूमीवर लघु लेखन करा.
2. Explain the concept of holistic healthcare. / समग्र आरोग्यसेवेची संकल्पना स्पष्ट करा.
3. State the significance of Charak Samhita in Indian healthcare. / भारतीय आरोग्यसेवेमधील चरक संहितेचे महत्त्व स्पष्ट करा.
4. Describe the concept and scope of traditional healthcare. / पारंपरिक आरोग्यसेवेची संकल्पना आणि व्याप्ती स्पष्ट करा.
5. Mention the contribution of Sushruta Samhita in surgery. / शल्यक्रियेत सुश्रुत संहितेचे योगदान नमूद करा.
6. Give an overview of Indian Systems of Medicine (ISM). / भारतीय वैद्यकीय प्रणाली (ISM) चे संक्षिप्त विवेचन करा.
7. What are the recent government initiatives in healthcare development? / आरोग्यविकासातील अलीकडील सरकारी उपक्रम कोणते?

Unit II

1. Write the medicinal uses of any two plants. / कोणत्याही दोन वनस्पतींचे औषधी उपयोग लिहा.
2. Describe the role of plants in traditional medicine. / पारंपरिक औषधांमध्ये वनस्पतींची भूमिका स्पष्ट करा.
3. Explain the importance of identifying medicinal plants. / औषधी वनस्पतींची ओळख पटविण्याचे महत्त्व स्पष्ट करा.
4. Write about the modern use of traditional medicine. / पारंपरिक औषधांचा आधुनिक उपयोग लिहा.
5. List any five medicinal plants and their uses. / कोणत्याही पाच औषधी वनस्पती व त्यांचे उपयोग लिहा.
6. What are the challenges in using traditional medicine in modern society? / आधुनिक समाजात पारंपरिक औषधांचा वापर करताना येणाऱ्या अडचणी कोणत्या?
7. How does traditional healthcare support global health? / पारंपरिक आरोग्य सेवा जागतिक आरोग्याला कशी मदत करते?

Unit III

1. Write short notes on decoctions and infusions. / क्वाथ आणि अर्क यावर लघु टिपणी लिहा.
2. Describe three types of external medicines. / तीन प्रकारच्या बाह्य औषधांचे वर्णन करा.
3. Explain the use of compresses in traditional medicine. / पारंपरिक औषधांमध्ये शेक देण्याचा उपयोग स्पष्ट करा.
4. What are herbal teas and their benefits? / हर्बल चहा म्हणजे काय व त्याचे फायदे काय?
5. Discuss the use of medicinal plant-based foods. / औषधी वनस्पती आधारित अन्नाचा उपयोग स्पष्ट करा.
6. Differentiate between herbalism and phytotherapy. / हर्बलिझम आणि फाइटोथेरपी यातील फरक स्पष्ट करा.
7. What is the significance of baths and soaks in therapy? / उपचारामध्ये स्नान व भिजवण्याचे महत्त्व काय?

Unit IV

1. Explain the ethics involved in traditional medicine usage. / पारंपरिक औषध वापरात असलेले नैतिक मुद्दे स्पष्ट करा.
2. Describe the role of clinical trials in THC. / पारंपरिक आरोग्य सेवांमध्ये नैदानिक चाचण्यांची भूमिका स्पष्ट करा.
3. Why is documentation important in traditional medicine? / पारंपरिक औषधात दस्तऐवजीकरण का महत्त्वाचे आहे?
4. What are the benefits of validating THC knowledge? / पारंपरिक आरोग्य ज्ञानाचे प्रमाणीकरण केल्याचे फायदे काय?
5. What is voluntary certification and who can get it? / ऐच्छिक प्रमाणपत्र म्हणजे काय व कोण ते घेऊ शकते?
6. Discuss ethical concerns in commercialization of THC. / पारंपरिक औषध व्यवसायीकरणातील नैतिक चिंता स्पष्ट करा.
7. What outcome measures are used in evaluating traditional therapies? / पारंपरिक उपचारांचे मूल्यमापन करताना कोणती मापन पद्धती वापरली जाते?

6-Mark Questions (Long Answers)

Unit I

1. Write in detail about the evolution of traditional healthcare systems in India. / भारतातील पारंपरिक आरोग्यसेवेच्या विकासावर सविस्तर लेखन करा.
2. Explain the role of Charak, Sushruta, and Ashtang Hridaya in the development of Ayurveda. / आयुर्वेदाच्या विकासात चरक, सुश्रुत व अष्टांग हृदय यांची भूमिका स्पष्ट करा.
3. Discuss the perspectives and policies related to health care in India. / भारतातील आरोग्याशी संबंधित दृष्टीकोन व धोरणे स्पष्ट करा.

Unit II

1. Explain in detail the role of plants in the Indian traditional healthcare system. / भारतीय पारंपरिक आरोग्य सेवांमध्ये वनस्पतींची भूमिका सविस्तर लिहा.
2. Describe the opportunities and limitations of using traditional plants in modern medicine. / आधुनिक औषधांमध्ये पारंपरिक वनस्पतींचा उपयोग करताना येणाऱ्या संधी व मर्यादा स्पष्ट करा.
3. Discuss the relevance of medicinal plants in pharmaceutical industries. / औषधनिर्माण उद्योगात औषधी वनस्पतींचे महत्त्व स्पष्ट करा.

Unit III

1. Describe the different types of internal and external medicines in traditional healthcare. / पारंपरिक आरोग्य सेवेमध्ये आंतर व बाह्य औषधांचे विविध प्रकार स्पष्ट करा.
2. Write in detail about dietary and therapeutic practices in plant-based healthcare. / वनस्पती आधारित आरोग्य सेवांमधील आहार व उपचार पद्धती सविस्तर लिहा.
3. Explain the scope and role of aroma therapy and herbalism in traditional healing systems. / पारंपरिक उपचार पद्धतीमध्ये सुगंधोपचार व हर्बलिझमची भूमिका व व्याप्ती स्पष्ट करा.

Unit IV

1. Explain the ethical guidelines required for responsible use of traditional medicine. / पारंपरिक औषधांच्या जबाबदार वापरासाठी आवश्यक नैतिक मार्गदर्शक तत्वे स्पष्ट करा.
2. Discuss the importance and process of clinical trials and documentation in THC. / पारंपरिक आरोग्य सेवेमध्ये नैदानिक चाचण्या व दस्तऐवजीकरणाचे महत्त्व व प्रक्रिया स्पष्ट करा.
3. Elaborate on voluntary certification and its significance for traditional healthcare practitioners. / पारंपरिक आरोग्य सेवा तज्ञांसाठी ऐच्छिक प्रमाणपत्राचे महत्त्व सविस्तर स्पष्ट करा.

VSC: Supply Chain Management of Seeds

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107219	Supply Chain Management of Seeds	2	60	4 Hrs	50

Course Objectives:

- To create opportunities of self-employment / student's startup through supply chain management of seed.
- To enrich students training and knowledge that would be useful in the seed industry so that the farmers will get quality seeds.
- To create awareness and involve seed producers in supply chain management.

Course Outcomes:

- Understand the Scope of seed industry and Supply chain management
- Demonstrate different methods of seed priming and packaging
- Understand: The concepts and significance of seed quality control
- Access: Major players in Seed Supply Chain management
- Analyze and compare the field inspection methods and steps for seed sampling
- Design Seed Marketing supply chain for promotion of quality seeds

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
I	**Fundamentals of Seed Supply chain management.**	15	12	Suitable pedagogical strategies are separately annexed
	1.1 Introduction to Supply chain management, scope and opportunities.			
	1.2 Stakeholders in seed supply chain; Breeders, Producers, Distributors and farmers.			
	1.3 SATHI (Seed Analytics, Technology, and Holistic Integration): Role in enriching the digital ecosystem for Seed.			
	1.4 Importance and promotion of quality seed, seed demand and supply systems.			
II	**Seed Quality Maintenance Technologies**	15	12	
	2.1 Seed priming: Physiological and biochemical basis, Coating, Pelleting & Hardening seed tapes, seed mats, seed coloring, biopriming			
	2.2 Packaging and labeling of seeds, handling, stacking and Logistics.			
	2.3 Seed Types- Nucleus Seeds, Breeder Seeds, Foundation Seeds, Hybrid Seeds & Certified Seeds			
	2.4 Maintenance of seed processing records.			
III	**Legislation and Certification**	15	12	
	3.1 Regulatory mechanisms of seed quality control- Government and nongovernment organizations, seed legislation and seed law enforcement, role of Central Seed Certification Board			
	3.2 Seed Certification Procedures- Steps Involved in Seed Certification Application for seed production, Registration of sowing report.:			
	3.3 Field inspection, Seed processing, Seed sample and seed analysis, Tagging and sealing. Certification of seeds as organic.			
	3.4 Case Histories of Some Seed Developer and business ventures			

IV	Seed Marketing and management	15	14	
	4.1 Seed marketing and trade, seed pricing and its policy			
	4.2 Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins			
	4.3 National seed policies, Role of various sectors/agencies in efficient seed marketing, quality control and assurance programme.			
	4.4 Responsibilities of seed companies and dealers under Seed Act 1996 & IPR for seed trade, Seed industry linkages.			

Conduct at least THREE Practicals from each unit:

Unit I:

1. Case study analysis of seed industry/ industrialist
2. Prepare a list of seed industries in India
3. To study the major stakeholders in seed supply chain management
4. Study of success story in seed marketing and trade (Any one from each Global and Indian viz.: Bayer Crop Science, Corteva Agriscience, Syngenta Group, Mahyco, Advanta Seeds (UPL), Ankur Seeds Pvt. Ltd., Nirmal Seeds Pvt. Ltd., etc.

Unit II:

1. To study seed treatments – seed priming
2. To study seed coating, pelleting, seed colouring and biopriming
3. To study seed packaging, closing and stacking
4. Demonstration of preparation for nucleus seed, breeder seeds, and hybrid seeds
5. Preparation of report on seed processing (any one seed plant)

Unit III:

1. Study and use of regulatory mechanism of seed quality control by the preparation of Govt & Non govt organization list.
2. Preparation sowing report for registration (any one plant)
3. Preparation of the Field inspection
4. Demonstration on seed sample collection, tagging and sealing
5. Preparation of the proposal for seed certification

Unit IV:

1. Demonstration for promotion of quality seed
2. To understand the process of calculation of the seed pricing
3. Preparation of distribution channel list and calculate marketing costs and margin
4. Understand and list the agencies involved in seed marketing and quality control
5. Seed industry linkages study (at least one)

Conduct at least TWO Activities from the following:

Field visits:

1. Visit to seed Production Company/ Industry
2. Visit to a seed quality enhancement technology-based production unit
3. Visit to seed testing laboratories/ research institute
4. Visit to seed certification body
5. Visit to authorized nearest dealers in seed marketing

Other activities –

1. Preparation of report on seed supply chain management
2. Case study on use of SATHI
3. Preparation of maintenance and seed processing record 9 any one plant)
4. Preparation field inspection report
5. Preparation of report on agencies involved in seed marketing

Collaboration/ MoU-

Conduct suggested activities in Collaboration / MoU with any seed company / related NGO/ Institute

References:

Reference Books:

- Agarwal, P. K. (Ed.). (1995). Handbook of Seed Technology for Genebanks - Volume II: Compendium of Specific Germination Information and Test Recommendations. International Board for Plant Genetic Resources.
- Agarwal, R. L. (2018). Seed Technology. Oxford and IBH Publishing.
- Baskin, C. C., & Baskin, J. M. (2014). Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Elsevier. This text offers an extensive review of seed ecology, an essential topic for understanding seed development and enhancement technologies.
- Basra, A. S. (Ed.). (2007). Handbook of seed science and technology. Scientific Publishers.
- Bewley, J. D., Bradford, K., Hilhorst, H., & Nonogaki, H. (2013). Seeds: Physiology of Development, Germination and Dormancy. Springer. This book covers the physiological aspects of seed development, germination, and dormancy, providing insights into the biochemical and environmental factors influencing these processes.
- Black, M., & Bewley, J. D. (Eds.). (2000). Seed technology and its biological basis. Crc Press.
- Justice, O. L., & Bass, L. N. (1978). Principles and Practices of Seed Storage. U.S. Department of Agriculture. This book provides foundational knowledge on seed storage techniques crucial for maintaining seed viability.
- Khare, D., & Bhale, M. S. (2016). Seed technology. Scientific publishers.
- McDonald, M. B., & Copeland, L. O. (1997). Seed Production: Principles and Practices. Springer.
- Patel, J.B. & Vaddoria (2018). Seed Technology: Progress and Recent Advances. New India Publishing Agency.
- Pichop, G. N. & Mndiga, H. S. (2007). Essentials of modern marketing management & supply chain systems for vegetable seed companies. AVRDC-World Vegetable Center.
- Ram, H. H. (2021). Commercial Plant Breeding: Volume 01 Vegetable Crops. India: NEW INDIA PUBLISHING AGENCY- NIPA.
- Stiller, S. F. (2011). Sustainable Seed Supply Chain Management: A Case Study on Syngentá s Indian Hybrid Vegetable Seed Supply Chain. (n.p.): CSM, Centre for Sustainability Management.

Digital Resources and E-Contents:

1) FAO Seed Portal: Offers comprehensive resources on seed policies, quality control, and legislation. URL: http://www.fao.org/seeds/en/
2) ISTA (International Seed Testing Association): Provides guidelines for seed testing and certification. URL: https://www.seedtest.org

Web Links for Seed Quality Enhancement Technologies:

1) SeedQuest: Covers the latest in seed technology and industry news. URL: http://www.seedquest.com

Database Links:

1) Germplasm Resources Information Network (GRIN): A database providing detailed information on various seed genetic resources. URL: https://npgsweb.ars-grin.gov/gringlobal/search.aspx

Pedagogies

1. **Entrepreneurial Project Development,** where students ideate, develop, and present a business plan related to the seed industry. This pedagogy combines market research, product development, and strategic planning.
2. **Mentorship Programs with industry experts** can provide personalized guidance, enhancing entrepreneurial skills and network building. These methods offer practical insights into business development, encouraging innovation and real-world application of course concepts.
3. **Project-Based Learning (PBL):** Engages students in real-world seed industry projects, enhancing their understanding and skills in a practical context.
4. **Flipped Classroom:** Utilizes online resources for theory, freeing up classroom time for interactive discussions, practical exercises, and guest lectures from industry professionals.
5. **Simulation Games and Virtual Labs:** Offers hands-on experience in seed production and quality control processes without the need for physical resources.
6. **Case Studies and Role Plays:** Encourages critical thinking and problem-solving through analysis of real-world challenges in the seed industry.
7. **Internships and Industry Visits:** Provides firsthand experience and insight into the operational aspects of seed companies and quality control organizations.

Question Paper for Internal Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)			
Practical-10	Course Code: 1071219	SUPPLY CHAIN MANAGEMNT IN SEED PRODUCTS	Max Marks: 50

Q. No.	Exercise	Marks
1	Any one exercise on seed processing	10
2	Preparation of any one report for submission to the official agency for certification/ registration/ pricing/ field inspection, etc.	10
3	Comment on the demonstration of the experiment based on Seed Marketing and management (Any Two)	10
4	Overall Performance throughout the semester	5
5	Record Book	5
6	Field visit / Activities under MoU or Collaboration report	5
7	Viva Voce	5
	Total	50

Field Project / Community Engagement Services in Botany: Phase-I

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	III	107220	Field Project / Community Engagement Services in Botany: Phase-I	2	60	--	50

Course Objectives:

- To develop an appreciation of biodiversity, indigenous plant knowledge, and sustainable ecological practices among students.
- To expose students to the interdependence between rural communities and plant resources.
- To study local environmental challenges and identify plant-based, community-driven solutions.
- To enable students to apply theoretical Botany concepts in real-life settings, enhancing the quality of experiential learning.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand the ecological, medicinal, and agricultural importance of native plants in rural areas.
- Build connections with local communities and learn from traditional ecological knowledge.
- Identify and assess plant-related challenges (e.g., deforestation, crop failure, invasive species, etc.) and suggest sustainable interventions.
- Appreciate the role of community participation in biodiversity conservation and environmental stewardship.
- Document and disseminate knowledge regarding plant resources and their potential applications.

Guidelines/ SoP for FP/CEP

For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf

As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks.

The guidelines regarding the field project are as follows:

1. Students must complete 60 hours of field engagement.
2. Work may be done individually or in groups of up to 4 students, each under a departmental faculty guide.
3. A survey or sample collection methodology must be chosen, with appropriate documentation tools: questionnaires, datasheets, plant specimen formats, etc.
4. Projects can be survey-based, experimental, observational, or intervention-based.
5. **Final report to include:** Title, Introduction, Materials & Methods, Results, Discussion, Conclusion, References.
6. Minimum 6 pages excluding cover page, certificate, acknowledgement, etc.
7. Poster/PPT presentation is mandatory and will be evaluated by an appointed examiner.

8. For a SURVEY based project related questionnaire (15 or more questions) shall be prepared.
9. The departmental coordinator/guide shall check the questions and finalize the questionnaire. The question that may create unnecessary complications should be avoided. The questions should be qualitative as well as quantitative.
10. If the project is related to work that does not involve survey work, then the questionnaire part can be replaced accordingly (e.g. Sample collection/Data collection/ Experimental base etc).
11. The total project work including preparation of questionnaire to presentation should be evaluated for 2 credits (50 Marks).

SUGGESTED FORMS OF COMMUNITY-ENGAGED PRACTICE IN BOTANY

Linking Botany with Community Service

- Create village herbariums with help from locals to preserve indigenous flora.
- Assist farmers in understanding plant disease identification and natural remedies.
- Educate school children on photosynthesis and plant care via live demonstrations.

Community-Based Plant Research

- Conduct field surveys on medicinal plants or invasive species in local ecosystems.
- Document ethnobotanical knowledge from tribal and rural elders.
- Study agroforestry systems and suggest botanical improvements.

Awareness & Knowledge Sharing

- Organize workshops on home gardening, composting, or afforestation.
- Conduct nutrition campaigns on the value of leafy greens, millets, and plant-based diets.
- Prepare easy-to-understand posters on medicinal plants and distribute in local schools/panchayats.

Social Innovation via Botanical Projects

- Build vertical gardens in limited-space households using low-cost materials.
- Create seed banks for climate-resilient plant varieties.
- Collaborate with local NGOs to restore degraded lands via native species plantation.

Examples of Botany-Specific Field Project Topics

1. Survey of endangered/rare plant species in a local forest area.
2. Study of plant-based home remedies and their community usage.

3. Soil and compost quality evaluation and its effect on vegetable growth.
4. Development of biodiversity gardens or butterfly parks in schools.
5. Leaf morphology variations and microclimate correlations in urban trees.
6. Promotion of millet-based agriculture and traditional grains.

Reference:

- Florida Department of Agriculture and Consumer Services. (n.d.). Science fair project ideas: Botany. https://www.fdacs.gov/Education/Planet-Ag-Agricultural-Topics-for-Science-Fair-Projects/Science-Fair-Project-Ideas-Botany
- University Grants Commission. (2023). Revised guidelines for community engagement and social responsibility. https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf
- American Chemical Society. (n.d.). Student community activities. https://www.acs.org/education/student-communities/activities.html
- IndiaBioscience. (n.d.). Outreach. https://indiabioscience.org/outreach

Assessment Rubric for FP/CEP: Phase-I

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – III (NEP)			
FP/CEP	**Course Code:** 107220	Field Project / Community Engagement Services in Botany: **Phase-I**	**Max Marks:** 50

Q. No.	Exercise	Marks
1	**Field Engagement & Participation** (Attendance, hands-on involvement, and community interaction)	15
2	**Project Report Quality** (Clarity, structure, scientific accuracy, originality, and referencing)	15
3	**Data Collection & Analysis** (Depth, relevance, and quality of survey/sample collection and its analysis)	10
4	**Presentation (Poster or PPT)** (Communication of findings, visual clarity, and confidence)	05
5	**Social Relevance & Innovation** (Creative solutions, awareness campaigns, or community impact beyond data.)	05

SEMESTER – IV

Type of Course	**Course Code**	**Course Name**
MJ-Theory	107221	Botanical Wealth – Economic Botany, Ethnomedicine and Phytochemistry
Mj-Theory	107222	Cellular Frontiers in Botany - Cell Biology, Cytogenetics and Molecular Biology
MJ-Practical-11	107223	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies
Mn-Theory	107224	Plant Propagation and Growth
Mn-Practical-12	107225	Investigations of Plant Life Sketch
GOEC-Theory	107226	Wonders of Plant World
Practical-13	107227	Nursery and Garden Management
Practical-14	107228	Skilling Botanists for Nursery and Garden Management
Theory		Refer University basket
Theory		Refer University basket
Project	107229	Field Project / Community Engagement Services in Botany: **Phase-II**
Outdoor		Separate SOP will be released

Major Course: Botanical Wealth: Economic Botany, Ethnomedicine and Phytochemistry

Level	Semester	Course code	Course Name	Credits	Teaching Hrs	Exam Duration	Maximum Marks
5.0	IV	107221	Botanical Wealth: Economic Botany, Ethnomedicine and Phytochemistry	2	2	2	30 (Ext.) + 20 (Int)

Course Objectives:

- To study the economic value and varieties of important food, fiber, oilseed, and commercial crops.
- To understand the traditional knowledge systems and cultural uses of plants among indigenous communities.
- To explore the significance of spices, fruits, vegetables, and their application in food processing industries.
- To learn the basic concepts and scope of pharmacognosy and phytochemistry in drug development.
- To gain practical knowledge of phytochemical techniques like TLC and HPTLC.
- To analyze and validate the ethnomedicinal uses of plants through phytochemical profiling.

Course Outcome

- Identify economically important plants and classify them based on their uses.
- Explain the traditional knowledge systems and ethnobotanical significance of selected medicinal plants.
- Demonstrate the applications of phytochemical techniques like TLC and HPTLC.
- Analyze the ethnomedicinal data collected from ethnic communities.
- Evaluate the pharmacognostic features and phytochemical contents of selected medicinal plants.
- Create a scientific report that validates ethnobotanical claims using phytochemical evidence.

Unit	Content	Workload Allotted (Hrs)	Weightage of Marks	Incorporation of pedagogies
I	**Economic Botany**	07	07	Use any pedagogical technique suitable for the topic
	1.1 Morphology, Varieties and Economic importance of Wheat and Arhar			
	1.2 Spices and Condiments: Cardamon and Turmeric.			
	1.3 Oilseed Crops: Soybean and Groundnut.			
	1.4 Commercial Crops: Economic importance of Banana and Sugarcane			
II	**Economic Botany**			
	2.1 Fiber-yielding crops: - Morphology, Varieties and economic importance of Cotton	08	08	
	2.2 Timber-yielding plants: Teak and Shisham			
	2.3 Vegetable & fruit plants: Mango and Potato			

	2.4 Applications of vegetables and fruits in food processing industry (Awala and Citrus).			
III	**Ethnobotany**			
	3.1 Definition, Ancient history and Importance of Ethnobotany. 3.2 Contribution of Indian ethnobotanists- Dr. S. K. Jain and Janaki Ammal.	08	08	
	3.3 Ethnomedicine uses Ashwagandha, Shatavari, Adulsa.			
	3.4 Role of ethnic groups (Gond, and Korku) in the development & Conservation of ethnomedicinal wealth. Ethnomedicinal Investigation: Study area and data collection (Documentation), Analysis & validation.			
IV	**Pharmacognosy & Phytochemistry**			
	4.1 Concept and scope of Pharmacognosy & Phytochemistry. Pharmacognosy of Adulsa and Shatavari.	07	07	
	4.2 Basic Techniques of Phytochemistry: Thin layer Chromatography and HPTLC (Principle, Working & Applications)			
	4.3 Major Phytochemicals: Types and application of Alkaloids, Phenolics, Flavonoids and Terpenes			
	4.4 Phytochemical profiling of Adulsa and Ashwagandha and validation of their ethnomedicinal uses.			

Bibliography

Reference / Text Books / Research Articles

1. Jain, S.K. (1995). *Manual of Ethnobotany*. Scientific Publishers, Jodhpur.
2. Kochhar, S.L. (2016). *Economic Botany in the Tropics*. Macmillan Publishers India.
3. Trease, G.E. & Evans, W.C. (2009). *Pharmacognosy*. 16th Ed., Elsevier Health Sciences.
4. Wallis, T.E. (2004). *Textbook of Pharmacognosy*. CBS Publishers & Distributors.
5. Dey, P.M. & Harborne, J.B. (1997). *Plant Biochemistry*. Academic Press.
6. Farnsworth, N.R. (1966). *Biological and Phytochemical Screening of Plants*. Journal of Pharmaceutical Sciences, 55(3): 225-276.
7. Sharma, P.V. (1999). *Dravyaguna Vijnana* (Materia Medica – Ayurvedic). Chaukhamba Bharati Academy.

2. E-Contents / E-Books (Free & Paid Sources)

1. NCBI Bookshelf – https://www.ncbi.nlm.nih.gov/books/
2. SpringerLink – Access to journals and books on plant sciences and ethnobotany.
3. Elsevier's ScienceDirect – Paid source with free preview articles https://www.sciencedirect.com
4. ResearchGate – Articles and papers shared by authors. https://www.researchgate.net
5. Central Council for Research in Ayurvedic Sciences (CCRAS). (n.d.). E-books. Ministry of AYUSH, Government of India. https://www.ccras.nic.in/content/e-books-0
6. Ministry of AYUSH. (n.d.). AYUSH Research Portal. Government of India. https://ayushportal.nic.in
7. Pharmacopoeia Commission for Indian Medicine & Homoeopathy (PCIM&H). (n.d.). Home. Ministry of AYUSH, Government of India. https://pcimh.gov.in

8. Government of India. (n.d.). The Ayurvedic Pharmacopoeia of India, Part I, Volume I. https://www.ayurveda.hu/api/API-Vol-1.pdf
9. Government of India. (n.d.). The Ayurvedic Pharmacopoeia of India, Part I, Volume II. https://www.ayurveda.hu/api/API-Vol-2.pdf
10. Government of India. (n.d.). The Ayurvedic Pharmacopoeia of India, Part I, Volume VII (Minerals & Metals). https://naturalingredient.org/wp/wp-content/uploads/API-Vol-7.pdf
11. Government of India. (n.d.). The Ayurvedic Pharmacopoeia of India, Part II, Volume I (Formulations). https://naturalingredient.org/wp/wp-content/uploads/API-II-Vol-1.pdf.

3. Digital Resources & Weblinks

1. Plant List Database – http://www.theplantlist.org
2. NAPRALERT Database – Natural Products Alert (Ethnobotany, phytochemistry): https://www.napralert.org
3. AYUSH Research Portal – https://ayushportal.nic.in
4. ICMR-NIN & CSIR-NIScPR Resources – Scientific resources for medicinal plant research.
5. ePG Pathshala (Botany & Pharmacognosy Modules) – https://epgp.inflibnet.ac.in/
6. Digital Herbarium – Botanical Survey of India – http://bsidb.nic.in
7. PubMed Central (PMC) – Free access to biomedical and phytochemical research: https://www.ncbi.nlm.nih.gov/pmc/

Answer in one sentence - (1 Mark Questions)

Unit 1: Economic Botany – I

1. Name any two economically important varieties of wheat.
2. What is the botanical name of Arhar (Pigeon pea)?
3. Name two commonly used spices in Indian cuisine.
4. Which part of turmeric is used as a condiment?
5. Write one medicinal use of cardamom.
6. Name the oilseed crop known for its high protein content.
7. Which part of the soybean plant is used for oil extraction?
8. Name the commercial product obtained from groundnut.
9. Name one commercial product obtained from sugarcane.

Unit 2: Economic Botany – II

1. Name one important variety of cotton cultivated in India.
2. What is the botanical name of Teak?
3. Mention one use of Shisham wood.
4. Name one plant that yields vegetable fiber.
5. Name one vegetable that is botanically a stem.
6. Which fruit is known for its high Vitamin C content?
7. Mention one industrial product made from Amla (Awala).
8. Which part of Citrus is used in food processing?
9. Name one processed product of mango.

Unit 3: Ethnobotany

1. Define ethnobotany
2. Name one Indian ethnobotanist who pioneered the field.
3. Mention one therapeutic use of Ashwagandha.
4. Name one ethnic tribe that uses herbal medicine.
5. Write the botanical name of Shatavari.
6. What is the use of Adulsa in traditional medicine?
7. Name one ethnic group from Maharashtra involved in ethnomedicine.
8. What is meant by ethnomedicinal documentation?
9. Write one reason why ethnobotanical validation is important.

Unit 4: Pharmacognosy & Phytochemistry

1. What is the meaning of Pharmacognosy?

2. Name one technique used in Phytochemical analysis.
3. What is the full form of HPTLC?
4. Name one alkaloid found in Ashwagandha.
5. Write one medicinal property of Adulsa.
6. What is the function of flavonoids in plants?
7. Name a terpenoid found in medicinal plants.
8. What is the full form of TLC?

3-Mark Questions (Short Answers)

Unit 1: Economic Botany – I

1. Describe the economic uses of Arhar.
2. Mention the commercial uses of Wheat in food and non-food industries.
3. Describe the economic importance of Cardamom.
4. Explain the spice value and applications of Turmeric.
5. Mention the nutritional and industrial uses of Soybean.
6. Write a short note on the economic uses of Groundnut.
7. Describe the commercial significance of Banana in food and industry.
8. Explain the industrial applications of Sugarcane and its by-products.

Unit 2: Economic Botany – II

1. Write a short account of cotton varieties and their industrial value.
2. Describe the importance of Teak wood in the timber industry.
3. Mention three economic uses of Shisham (Dalbergia sissoo).
4. Discuss the role of Mango and Potato in food and agro-economy.
5. Write a short note on food processing products of Amla (Awala).
6. Explain the role of Citrus fruits in the food industry and health sector.

Unit 3: Ethnobotany

1. Describe the historical development and scope of ethnobotany.
2. Write a short note on Dr. S. K. Jain's contributions to ethnobotany.
3. Mention three medicinal uses of Shatavari.
4. Describe the traditional uses of Adulsa in local communities.
5. Explain the role of Gond tribe in ethnomedicinal practices.
6. Describe the methods of data collection and documentation in ethnobotany.

Unit 4: Pharmacognosy & Phytochemistry

1. Write a short note on the concept and scope of pharmacognosy.
2. Explain the principle and applications of Thin Layer Chromatography (TLC).
3. Mention the working and uses of HPTLC in plant drug research.
4. Write a short note on Alkaloids and their pharmaceutical importance.
5. Describe the health benefits of flavonoids and phenolics.
6. Explain the role of phytochemical profiling in validating medicinal uses.

6-Mark Questions (Long Answers)

Unit 1: Economic Botany – I

1. Describe the varieties and economic significance of Wheat in Indian agriculture.
2. Describe the varieties and economic significance of Arhar in Indian agriculture
3. Give a detailed account of Cardamom as important spices and condiments.
4. Give a detailed account of Turmeric as important spices and condiments.
5. Explain the economic uses Soybean and Groundnut.
6. Elaborate the commercial and industrial applications of Banana and Sugarcane.

Unit 2: Economic Botany

1. Discuss the varieties and economic importance of cotton as a fiber crop.
2. Explain the timber value and industrial applications of Teak and Shisham.
3. Describe the nutritional and commercial uses of Mango and Potato.
4. Write a detailed account on the role of Amla and Citrus fruits in the food processing industry.

Unit 3: Ethnobotany

1. Define ethnobotany and explain its historical background and importance in modern science.
2. Elaborate the ethnomedicinal uses and pharmacological importance of Ashwagandha, and Adulsa.
3. Elaborate the ethnomedicinal uses and pharmacological importance of Shatavari and Adulsa.
4. Describe the contribution of Gond and Korku tribes in the conservation and use of ethnomedicinal plants.
5. Write a detailed account of ethnomedicinal investigation – from field documentation to validation.

Unit 4: Pharmacognosy & Phytochemistry

1. Describe the principle, procedure, and application of Thin Layer Chromatography and HPTLC.
2. Explain the classification, role, and therapeutic uses of alkaloids, phenolics, flavonoids, and terpenes.
3. Discuss the phytochemical profiling of Adulsa and Ashwagandha and validate their ethnomedicinal significance.

Major Course: Cellular Frontiers in Botany: Cell Biology, Cytogenetics and Molecular Biology

Level	Semester	Course code	Course Name	Credits	Teaching Hrs	Exam Duration	Max Marks
5.0	IV	107222	Cellular Frontiers in Botany: Cell Biology, Cytogenetics and Molecular Biology	2	2	2	30 (Ext.) 20 (Int)

Course Objectives:

- Introduce cell theory, compare prokaryotic and eukaryotic cells, and describe the structure and function of cell organelles, including mitochondria and chloroplasts.
- Explain the structure, types, and behavior of chromosomes, and outline the phases and significance of mitosis and meiosis.
- Differentiate structural and numerical chromosomal aberrations, and analyze the role of semi-autonomous organelles in cell function.
- Evaluate experimental evidence establishing DNA as genetic material, and interpret the mechanisms of DNA replication and gene regulation.
- Integrate knowledge of the central dogma, transcription, translation, and transposable elements to understand gene expression and regulation mechanisms.

Course Outcome

- Understand the structure and organization of prokaryotic and eukaryotic cells.
- Describe the structure and function of cell organelles and semi-autonomous organelles.
- Explain the structure and classification of chromosomes and phases of the cell cycle.
- Analyze chromosomal aberrations and their biological significance.
- Justify DNA as the genetic material and explain its structure and replication.
- Describe transcription, translation, and gene regulation in prokaryotes.

Unit	Content	Workload Allotted (Hrs)	Weightage of Marks	Incorporation of pedagogies
I	**Cell and Cellular Organelles**	07	07	Use any pedagogical technique suitable for the topic
	1.1 The Cell: Historical background, Cell theory, structure and Comparative account of Prokaryotic and Eukaryotic cells.			
	1.2 Cell organelles: Structure and function of Nucleus, Ribosomes, Endoplasm reticulum & Golgi complex			
	1.3 Mitochondrial and Chloroplast: Semi-autonomous cell organelles (Mt DNA and Cp DNA)			
	1.4 Cytoskeleton: Microfilament, microtubules and Intermediate filaments			
II	**Cytogenetics**			

	2.1 Structure and types of Chromosomes: General structure, types - metacentric, submetacentric, acrocentric, telocentric	08	08	
	2.2 Cell cycle and phases of cell cycle: Mitosis, Meiosis and their significance.			
	2.3 Chromosomal aberrations (Structural): Deletion, Duplication, Inversion, Translocation, and their evolutionary significance			
	2.4 Chromosomal Aberrations (Numerical): **Euploidy** Triploidy, Tetraploidy & Polyploidy); **Aneuploidy** (Monosomy, Trisomy &Tetrasomy)			
III	**Genetic Material**			
	3.1 DNA as Genetic Material (Griffiths experiment and Hershey & Chase experiment)	08	08	
	3.2 Structure and Composition of DNA; Double helix model of DNA.			
	3.3 Replication of DNA: Mechanism in prokaryotes			
	3.4 Transposons- Types (IS elements, and Retrotransposons) and Ac-DS system in Maize			
IV	**Gene Expression and Regulation**			
	4.1 Central Dogma of Molecular biology	07	07	
	4.2 Transcription in prokaryotes and types of RNA			
	4.3 Genetic Code- Characteristics and Translation in Prokaryotes			
	4.4 Gene regulation: Operon concept (example-Lac Operon)			

References

- Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley & Sons. Inc.
- De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.
- Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
- Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
- Gupta, P.K. (2009). Genetics. Rastogi Publications, Meerut (India)
- Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley & Sons Inc., India. 5 th edition.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings, U.S.A. 9 th edition.
- Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10 th edition.

Model Questions:

UNIT 1: Cell and Cellular Organelles

1 Mark Questions:

1. Who proposed the cell theory?
2. What is the basic difference between prokaryotic and eukaryotic cells?
3. Which cell organelle is known as the control center of the cell?
4. Name the organelle responsible for protein synthesis.
5. What is the function of the Golgi complex?
6. Which organelle contains hydrolytic enzymes?
7. What is the function of peroxisomes?
8. Name the DNA found in mitochondria.
9. What is the main function of microtubules?

UNIT 2: Cytogenetics

1 Mark Questions:

1. Name the four types of chromosomes based on centromere position.
2. What is the shape of a metacentric chromosome?
3. What are the two main phases of the cell cycle?
4. During which phase does crossing over occur?
5. What is meant by chromosomal deletion?
6. Define duplication.
7. What is inversion?
8. Name two types of euploidy.
9. Define monosomy.
10. What is trisomy?

UNIT 3: Genetic Material

1 Mark Questions:

1. Which experiment proved that DNA is the genetic material?
2. Name the scientists who performed the transformation experiment.
3. What is the full form of DNA?
4. Who proposed the double helix model of DNA?
5. In which direction does DNA replication occur?
6. What is the function of DNA polymerase?
7. What are IS elements?
8. Define retrotransposons.
9. What are Ac-DS elements?
10. Name the organism in which Ac-DS elements were discovered.

UNIT 4: Gene Expression and Regulation

1 Mark Questions:

1. What is the central dogma of molecular biology?
2. Name the three types of RNA.
3. What is a codon?
4. Define genetic code.
5. What is meant by translation?
6. In which organism is the Lac operon studied?
7. What induces the Lac operon?
8. What is the function of tRNA?
9. Name the enzyme involved in transcription.
10. What is an operon?

Short Answer - 3 Mark Questions:

UNIT 1: Cell and Cellular Organelles

1. Compare prokaryotic and eukaryotic cells.
2. Describe the structure and function of the nucleus.

3. Mention the functions of ribosomes and ER.
4. Write a note on the role of lysosomes and peroxisomes.
5. Explain the significance of mitochondrial and chloroplast DNA.
6. Describe the components and functions of the cytoskeleton in eukaryotic cells.

UNIT 2: Cytogenetics

1. Describe the general structure of a chromosome.
2. Write a short note on different types of chromosomes.
3. Describe the phases of mitosis.
4. Explain the significance of meiosis.
5. Describe Deletion
6. Describe Duplication
7. Describe Inversion
8. Describe Translocation
9. Describe aneuploidy
10. Explain Polyploidy
11. Differentiate Autopolyploidy and Allopolyploidy
12. Explain Trisomy

UNIT 3: Genetic Material

1. Describe Griffith's experiment and its outcome.
2. Write a short note on the Hershey and Chase experiment.
3. Describe the structure of DNA.
4. Describe the composition of DNA
5. Explain the concept of the double helix model.
6. Describe the process of DNA replication in prokaryotes.
7. Write a short note on types of transposons.

UNIT 4: Gene Expression and Regulation

1. Explain the central dogma of molecular biology.
2. Describe transcription in prokaryotes.
3. Describe the functions of RNA.
4. Explain structure of transfer RNA
5. Describe m- RNA
6. Explain the properties of the genetic code.
7. Describe the process of translation in prokaryotes.
8. Describe operon concept.
9. Explain Structural gene in operon

Long answer 6 Mark Questions:

UNIT 1: Cell and Cellular Organelles

1. Describe the historical background, differences between prokaryotic and eukaryotic cells.
2. Explain the structure and functions of cell organelle nucleus
3. Explain the structure and functions of ER, and Golgi complex.
4. Discuss the semi-autonomous nature of mitochondria and chloroplasts with special reference to their DNA.
5. Describe the components and functions of the cytoskeleton in eukaryotic cells.

UNIT 2: Cytogenetics

1. Describe the structure and classification of chromosomes based on centromere position.
2. Explain the stages of mitosis and their biological importance
3. Explain the stages of meiosis I.
4. Discuss structural chromosomal aberrations.
5. Describe polyploidy with suitable examples.
6. Describe aneuploidy in detail.

UNIT 3: Genetic Material

1. Describe the structure and double helix model of DNA.
2. Describe structure and composition of DNA
3. Explain the mechanism of DNA replication in prokaryotes.

UNIT 4: Gene Expression and Regulation

1. Discuss the central dogma of molecular biology and its significance.
2. Explain the process of transcription in prokaryotes.
3. Explain the types of RNA.
4. Describe the characteristics of the genetic code
5. Explain the mechanism of translation in prokaryotes.
6. Discuss gene regulation in prokaryotes with special reference to the Lac operon.

Major Practical – 11: Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107223	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies	2	60	4 Hrs	25 (Ext)+ 25 (Int)

Course Objectives:

- To introduce students to the economic, medicinal, and ethnobotanical importance of plants.
- To develop skills in microscopic, morphological, anatomical, and biochemical analysis of plant materials.
- To understand the scientific basis of traditional and indigenous plant usage.
- To gain hands-on experience in cell biology, cytogenetics, and phytochemical techniques.
- To promote conservation ethics through documentation of tribal and ethnomedicinal knowledge.
- To expose students to basic chromatographic and spectroscopic techniques.
- To enhance observation, analysis, and documentation skills through plant-based case studies.

Course Outcomes:

- Understand and evaluate the economic and industrial importance of food, fiber, spice, and oil-yielding plants.
- Identify and document medicinal plants and their ethnobotanical uses across indigenous communities.
- Apply pharmacognostic and phytochemical techniques for quality control and validation of herbal drugs.
- Perform cytological experiments and understand cell division, chromosome structure, and anomalies.
- Analyze phytochemical constituents using classical and modern laboratory techniques.
- Demonstrate the ability to carry out basic scientific documentation, herbarium preparation, and lab records.
- Develop ethical awareness of conservation practices and traditional plant knowledge systems.

Practical List

Set -A (Any Six)

1. Morphological and Economic Study of Wheat (*Triticum aestivum*) and Arhar (*Cajanus cajan*).
2. Study and Identification of Spices and Oilseeds: Cardamom, Turmeric, Soybean, and Groundnut.
3. Identification and Evaluation of Economic Uses of Banana, Sugarcane, Cotton, and Jute.
4. Ethnomedicinal Study and Identification of Adulsa (*Justicia adhatoda*), Shatavari (*Asparagus racemosus*), and Ashwagandha (*Withania somnifera*).
5. Field-Based Documentation of Ethnobotanical Knowledge from Local Tribes or Ethnic Communities.
6. Pharmacognostic Study of Crude Drugs – Ashwagandha and Adulsa (Microscopic and Organoleptic Analysis).
7. Preliminary Phytochemical Screening of Herbal Extracts (Adulsa and Ashwagandha) for Alkaloids, Flavonoids, Phenolics, and Terpenes.
8. Demonstration of Thin Layer Chromatography for Phytochemical Analysis.

Set-B (Any Six)

1. Squash preparation using Onion root tips (to observe stages of Mitosis).
2. Smear preparation using Rheo or Onion buds (to observe stages of Meiosis).
3. Study of special chromosomes (Polytene and Lampbrush) by either photograph or slides.
4. To study prokaryotic cells and eukaryotic cells.
5. Study of the photomicrographs of cell organelles (Nucleus, Mitochondria, Chloroplast, etc.).
6. To study the structure of plant cell through temporary mounts.
7. Preparation of the karyotype and ideogram from given photograph of somatic metaphase chromosome.
8. Study of aneuploidy: Down's, Klinefelter's, and Turner's syndromes using charts/photographs.
9. Observation of photographs or permanent slides showing Translocation Ring, Laggards, and Inversion Bridge.

Bibliography

Reference / Text Books / Research Articles:

1. Vashishta, B. R., Sinha, A. K., & Singh, V. P. (n.d.). Economic botany. S. Chand Publishing.
2. Jain, S. K. (1987). Manual of ethnobotany (2nd ed.). Scientific Publishers.
3. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2008). Pharmacognosy (46th ed.). Nirali Prakashan.
4. Evans, W. C., & Trease, G. E. (2009). Trease and Evans pharmacognosy (16th ed.). Saunders Elsevier.
5. Lewin, B. (2008). Genes IX. Jones & Bartlett Learning.
6. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (1991). Principles of genetics (8th ed.). John Wiley & Sons.
7. De Robertis, E. D. P., & De Robertis, E. M. F. (2001). Cell and molecular biology (8th ed.). Lippincott Williams & Wilkins.
8. Swaminathan, M. S. (n.d.). Scientific papers on biodiversity and ethnobotany. M.S. Swaminathan Research Foundation.

Journals:

9. Journal of Ethnopharmacology. (n.d.). Various articles. Elsevier. Retrieved from https://www.sciencedirect.com/journal/journal-of-ethnopharmacology
10. Indian Journal of Traditional Knowledge. (n.d.). Various articles. CSIR-NIScPR. Retrieved from https://nopr.niscpr.res.in/handle/123456789/43
11. Phytochemistry. (n.d.). Various articles. Elsevier. Retrieved from https://www.sciencedirect.com/journal/phytochemistry

E-Contents / E-Books (Free & Paid Sources):

- NCERT Biology PDFs (Free): https://ncert.nic.in
- NPTEL Lectures on Botany & Pharmacognosy: https://nptel.ac.in
- Google Books / Internet Archive – Open access phytochemistry and ethnobotany books
- PubMed Central (Research articles): https://www.ncbi.nlm.nih.gov/pmc/
- ResearchGate for accessing shared research articles by authors

Digital Resources & Weblinks

- Plant List Database: http://www.theplantlist.org/
- India Biodiversity Portal: https://indiabiodiversity.org/
- e-Flora of India: https://efloraofindia.com/
- Kew Plant Database: https://powo.science.kew.org/
- AYUSH Research Portal: http://ayushportal.nic.in/
- Chromosome Atlas: https://www.ncbi.nlm.nih.gov/genome/tools/karyoview/
- Virtual Microscopy for Mitosis/Meiosis: https://www.cellsalive.com/
- Botanica Digital Herbarium Tools: https://herbarium.univie.ac.at/

Question Paper for External Practical Course on Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)				
MJ-Practical-11	107223	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies	Max Marks: 25	Time: 4 Hrs.

Q.No.	Exercise	Marks
1.	Squash / Smear preparation	5
2.	Morphological and Economic Study of food crops/ oil seeds /Fibre crops (Any one)	5
3.	Pharmacognostic Study of Crude Drugs/ Preliminary phytochemical test (Any one)	5
4.	Spotting (5 spots – 1 -Ethnomedicinal plant, 2- Food crops / oil seeds/ spices / Fibre crops, 1 - cell organelles, 1 – Euploidy /Aneuploidy	5
5.	External Viva Voce	5

Assessment Rubric for Internal Practical Course on Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)			
Lab/ Practical-8	107223	Experimental Botany in Economic, Medicinal, Cellular and Molecular Studies	Max Marks: 25

S. No.	Assessment Criteria	Marks
1	Record/ Assignments	5
2	Attendance	5
3	Participation in Activity/ Field visit	5
4	Students overall performance	5
5	Internal Viva Voce	5

Minor Theory Course: Plant Propagation & Growth

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107224	Plant Propagation & Growth	2	30	2 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To identify various vegetative propagation methods like bulbs, runners, rhizomes, and suckers.
- To describe the process of growth at the cellular level, growth regulators, and their role in plant growth and development.
- To apply knowledge of photoperiodism and vernalization in controlling plant flowering and growth patterns.
- To analyze the various methods of pollination, fertilization, and post-fertilization development in angiosperms.
- To evaluate the significance of plant breeding techniques in enhancing plant growth, yield, and quality.

Course Outcomes:

- Identify and differentiate natural and artificial methods of plant propagation and their limitations.
- Explain the role of plant growth regulators, photoperiodism, and vernalization in plant growth and development.
- Apply various methods of measuring plant growth such as height, biomass, and growth index.
- Analyze the role of environmental factors, diseases, and stress conditions affecting plant growth.
- Evaluate the importance of plant breeding, tissue culture, and advanced growth methods in increasing plant productivity.
- Design and formulate plant growth assessments through case studies, growth measurement experiments, and practical demonstrations.
- Investigate the importance of greenhouses, polyhouses, and hydroponics in advanced plant growth.
- Develop practical skills in plant propagation, growth measurement, and plant breeding techniques.
- Implement advanced growth methods and develop solutions to counter plant stress and diseases.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Plant Propagation Methods**	8	8	Suitable pedagogical strategies are separately annexed
	1.1 Propagation Methods: Seed propagation and limitations			
	1.2 Vegetative propagation methods: bulbs, runners, rhizomes, and suckers			
	1.3 Propagation Media: Natural and Artificial			
	1.4 Micropropagation Techniques: Overview of plant tissue culture and economic importance			
Unit II	**Plant Growth and Development**	7	7	
	2.1 Plant Growth: Vegetative and Reproductive			

	2.2 Development: Shoot Apical Meristem (SAM) and Root Apical Meristem (RAM) – structure, zones, and role in primary growth			
	2.3 Vegetative to reproductive phase change: Transformation of vegetative shoot in to Reproductive structure			
	2.4 Stress Physiology: Factors causing stress in plants (Temperature, Salinity, Water)			
Unit III	**Sexual Reproduction in Plants**	8	8	
	3.1 Overall process of Sexual Reproduction in plants (Lower Plants to Higher Plants)			
	3.2 Male and Female Gametophytes in Angiosperms: Structure and functions of Pollen Grains and Embryo Sac			
	3.3 Fertilization: Double Fertilization and Triple Fusion in angiosperms and its significance			
	3.4 Post fertilization Development: Seed and fruits formation, Parthenocarpy and its significance			
Unit IV	**Plant Growth Assessment**	7	7	
	4.1 Growth assessment: Techniques to measuring plant height, biomass, and leaf area, growth index			
	4.2 Plant Breeding: Conventional method for enhancement of growth and yield			
	4.3 Advanced growth methods: Greenhouses, polyhouses, and hydroponics			
	4.4 Factor affecting Growth and development: Environmental factor, disease causing organism, Case study of local plant diseases			

Suggested Activities (Any Two from the following:

1. Survey of Vegetative Propagation Techniques in Local Nurseries

Students will visit nearby nurseries, botanical gardens, or local farms to observe and document various vegetative propagation methods such as grafting, budding, layering, rhizomes, and suckers. The goal is to analyze which techniques are most commonly used, why they are preferred, and their economic or ecological significance. Students will submit a field report with photographs, technique descriptions, and interviews (if applicable), thereby connecting classroom theory to real-world horticultural practices.

2. Artificial Propagation (Grafting/Layering/Cutting)

In this hands-on activity, students will perform one artificial propagation technique—such as stem cutting, air layering, or wedge grafting—either in a controlled lab setting or at home under supervision. They will document the procedure step by step, record observations over a 1–2 week period, and reflect on success rates and challenges. This activity enhances practical understanding of plant regeneration techniques critical in both agriculture and conservation.

3. Tracking Plant Growth Over Time

Students will grow a fast-germinating plant (such as mung bean or radish) and track its growth by measuring height, number of leaves, and visible biomass daily for two weeks. They will plot the data on a graph to visualize the growth curve, analyze growth stages, and comment on environmental variables affecting development. This exercise develops scientific observation, record-keeping, and analytical interpretation skills.

4. Presentation on Innovations in Plant Growth and Propagation

Students will prepare a brief (5–7 minute) oral or visual presentation on topics such as hydroponics, photoperiodism in agriculture, the use of plant hormones in horticulture, or micropropagation for biodiversity conservation. The presentation should include scientific content, applications, and challenges. This activity strengthens communication skills and deepens conceptual understanding through creative expression and peer learning.

5. Case Study on Local Plant Disease Affecting Growth

Students will research or interview local farmers to understand the occurrence and impact of a common plant disease (e.g., wilt in tomatoes, powdery mildew in cucurbits). They will document the disease's symptoms, causal organisms, transmission, prevention, and treatment practices. A short case study report or community-facing awareness poster will be submitted. This task builds diagnostic thinking and ties plant health to community well-being.

6. Quiz on Plant Growth Regulators and Reproduction Concepts

A short quiz will be conducted covering topics like auxins, gibberellins, reproductive structures, and tissue culture methods. Questions will include factual recall, true/false, matching, and application-based multiple-choice items. This ensures ongoing reinforcement of core concepts and provides feedback on student progress throughout the course.

7. Design a Home-Based Micropropagation Setup

Students will conceptualize and sketch a basic model of a micropropagation setup that could be used at home or in a low-resource setting. They will include necessary materials (e.g., glass jars, agar media, sterilization techniques), potential plants for culture, and economic feasibility. This thought experiment nurtures creativity and practical planning, especially relevant in regions where high-end lab facilities are not easily accessible.

8. Comparative Study of Growth Media

Students will grow the same plant species using different growth media—soil, cocopeat, compost, or hydrogel—and observe variations in growth over a two-week period. They will record parameters like germination time, root length, and shoot height, followed by a comparative analysis. This activity promotes experimental thinking and connects to environmental sustainability discussions.

Bibliography–

Reference Books:

- Bhojwani, S. S., & Razdan, M. K. (2005). Plant tissue culture: Theory and practice (Revised ed.). Elsevier.
- Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2014). *Plant Propagation: Principles and Practices* (9th ed.). Pearson Education.
- Hartmann, H. T., Kester, D. E., Davies, F. T., & Geneve, R. L. (2010). Plant propagation: Principles and practices (8th ed.). Prentice Hall.
- Jain, S. K. (1987). Manual of ethnobotany (2nd ed.). Scientific Publishers.
- Kochhar, S. L. (2011). Plant physiology (3rd ed.). Cambridge University Press India.
- Kumar, A., & Nanda, S. (2020). *Basics of Plant Physiology and Propagation Techniques*. New Delhi: Agrobios (India).
- Lewin, B. (2008). Genes IX. Jones & Bartlett Learning.
- Raven, P. H., Evert, R. F., & Eichhorn, S. E. (2005). Biology of plants (7th ed.). W.H. Freeman and Company.

- Sharma, J. R. (2015). *Principles of Plant Breeding* (2nd ed.). New Delhi: Oxford & IBH Publishing.
- Singh, B. D. (2014). Plant breeding: Principles and methods (10th ed.). Kalyani Publishers.
- Singh, P. (2021). *Plant Growth and Development* (3rd ed.). New Delhi: Rastogi Publications.
- Swaminathan, M. S. (n.d.). Scientific papers on biodiversity and ethnobotany. M.S. Swaminathan Research Foundation.
- Taiz, L., Zeiger, E., Moller, I. M., & Murphy, A. (2015). Plant physiology and development (6th ed.). Sinauer Associates.
- Vashishta, B. R., Sinha, A. K., & Singh, V. P. (n.d.). Botany for degree students: Plant physiology and metabolism. S. Chand Publishing.

Research Articles

- Chen, K., Li, G., Bian, X., Zheng, L., & Wang, Q. (2021). Effects of plant growth regulators on crop growth, yield, and quality: A review. *Journal of Plant Growth Regulation*, *41*(2), 123-134. https://doi.org/10.1007/s00344-020-10142-0
- Rai, M., Pandey, S., & Soni, B. (2022). Hydroponics: A sustainable approach to modern agriculture. *International Journal of Agricultural Sciences*, *18*(4), 356-365. https://doi.org/10.1007/s40003-022-01045-9
- Choudhury, H., & Roy, D. C. (2020). Innovation in propagation of fruit, vegetable and ornamental plants. *Horticulturae*, *6*(2), 23. https://doi.org/10.3390/horticulturae6020023
- Patel, P. K., & Prajapati, H. R. (2023). Plant propagation techniques. In *Fundamentals of Horticulture* (Chapter 7). ResearchGate. https://www.researchgate.net/publication/383360843_CHAPTER_-7_Plant_propagation_techniques
- Grieneisen, M. L. (2011). Plant growth and development: Basic knowledge and current views. *Mathematical Modelling of Natural Phenomena*, *6*(2), 1–17. https://www.mmnp-journal.org/articles/mmnp/pdf/2011/02/mmnp201162p1.pdf
- Kapoor, R., Giri, B., & Mukerji, K. G. (2004). Improved growth and essential oil yield and quality in *Foeniculum vulgare* Mill. on mycorrhizal inoculation supplemented with P-fertilizer. *Bioresource Technology*, *93*(3), 307–311. https://doi.org/10.1016/j.biortech.2003.11.015
- Pennisi, E. (2009, June 24). A cloning breakthrough — in plants. *Wired Science*. https://www.wired.com/2009/06/cropcloning
- Wikipedia contributors. (n.d.). *Plant propagation*. In *Wikipedia, The Free Encyclopedia*. Retrieved April 14, 2025, from https://en.wikipedia.org/wiki/Plant_propagation

Answer in one sentence - 1-Mark Questions:

Unit 1: Plant Propagation Methods

1. What is seed propagation?
2. Name a plant that propagates through bulbs.
3. Name one plant that propagates through rhizomes.
4. Define grafting.
5. What is budding in plant propagation?
6. Name any one artificial method of vegetative propagation.
7. What is micropropagation?
8. Mention one economic importance of micropropagation.

Unit 2: Plant Growth and Development

1. Define growth curve.
2. Name any two phases of the growth curve.
3. What are plant growth regulators?
4. Name any two plant hormones.
5. What is the role of ethylene in plants?
6. What is photoperiodism?
7. What is vernalization?
8. Name one stress factor affecting plant growth.

Unit 3: Sexual Reproduction in Plants

1. Name the male reproductive organ of a flower.

2. What is the female part of a flower called?
3. Define pollination.
4. Name one pollinating agent.
5. What is self-pollination?
6. Define fertilization in plants.
7. Define parthenocarpy.

Unit 4: Plant Growth Assessment

1. Name one technique used to measure plant height.
2. What is biomass in terms of plant growth?
3. Define growth index.
4. What is plant breeding?
5. What is a greenhouse?
6. Define polyhouse.
7. What is hydroponics?

Short Answer 3-Mark Questions:

Unit 1: Plant Propagation Methods

1. Explain seed propagation and mention any two.
2. Describe vegetative propagation through bulbs and runners.
3. Write a short note on propagation using rhizomes and suckers.
4. Explain the process of grafting.
5. Describe budding
6. Write a short note on stem and root cuttings.
7. Explain micropropagation.
8. Explain the basic concept of plant tissue culture.
9. Importance of micropropagation.

Unit 2: Plant Growth and Development

1. Explain growth at the cellular level with an example.
2. Describe its phases of Growth curve
3. Write a short note on any two plant growth regulators.
4. Role of auxins.
5. Role of cytokinin.
6. Write a short note on the application of gibberellins in agriculture.
7. Explain photoperiodism.
8. Describe concept and significance of vernalization.
9. Explain how salinity affects plant growth.
10. Explain water stress affect physiological processes in plants

Unit 3: Sexual Reproduction in Plants

1. Describe the structure of a flower as a reproductive organ.
2. What are the different parts of a flower and their functions?
3. Explain self-pollination
4. Explain cross-pollination.
5. Explain different pollinating agents
6. Explain the process of fertilization in flowering plants.
7. Describe double fertilization
8. Define parthenocarpy.

Unit 4: Plant Growth Assessment

1. Write a note on techniques for measuring plant height and biomass.
2. What is growth index? How is it calculated?
3. Explain the method of measuring leaf area in plants.
4. Describe the role of plant breeding in improving crop yield.
5. Write a short note on conventional plant breeding techniques.
6. What are greenhouses? How do they support plant growth?
7. Explain the importance of polyhouses in horticulture.
8. What is hydroponics? Mention any two advantages.
9. Describe basics of hydroponics

Long answer for 6 Marks

Unit 1: Plant Propagation Methods

1. Describe seed propagation in detail. What are its advantages and limitations?
2. Explain various vegetative propagation methods with suitable examples of bulbs, runners, rhizomes, and suckers.
3. Discuss artificial propagation methods—grafting, budding and cuttings.
4. What is micropropagation? Describe the steps involved in plant tissue culture and its economic significance.

Unit 2: Plant Growth and Development

1. Explain plant growth at the cellular level. Describe the growth curve with a neat diagram and phases.
2. Describe role of plant growth regulators auxins and cytokinin.
3. Describe Physiological role of Gibberellins and ethylene
4. What is photoperiodism? Explain its role in flowering and classify plants based on light requirement.
5. Define vernalization. Explain its significance.

Unit 3: Sexual Reproduction in Plants

1. Describe the structure of a typical flower. Explain its reproductive parts and functions in detail.
2. Explain types of pollination and describe the role of different pollinating agents with examples.
3. Describe the process of fertilization in angiosperms. Mention the significance of double fertilization.

Unit 4: Plant Growth Assessment

1. Describe various techniques used for plant growth assessment including measurement of height, biomass, leaf area, and growth index.
2. What is plant breeding? Explain conventional breeding methods for improving plant growth and yield.
3. Describe modern plant growth systems hydroponics, with advantages.
4. Explain various factors affecting plant growth and development.

Minor Practical – 12: Investigations of Plant Life Sketch

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107225	Investigations of Plant Life Sketch	2	60	4 Hrs	25 (Ext) +25 (Int)

Course Objectives:

- To understand the various natural and artificial methods of plant propagation.
- To study plant growth patterns and the role of plant growth regulators.
- To comprehend the mechanisms of reproduction in flowering plants.
- To analyze techniques for measuring plant growth and understand modern methods to enhance plant productivity.
- To identify and document local plant diseases and their impact on growth and development.

Course Outcomes:

- Differentiate and demonstrate seed, vegetative, and artificial propagation methods.
- Understand the stages of plant growth and interpret growth curves and regulators.
- Gain knowledge of floral structures, pollination mechanisms, fertilization, and fruit development.
- Acquire skills in measuring growth parameters and identifying plant diseases.
- Develop awareness of plant propagation technologies such as micropropagation and modern growth enhancement methods.

Practical List (Any 10)

1. Study of seed germination and seedling development in dicots and monocots.
2. Observation of vegetative propagation structures: bulbs, rhizomes, runners, suckers (with specimens).
3. Practice of artificial propagation methods: grafting, budding, layering, and cuttings (demonstration).
4. Demonstration of basic micropropagation technique using plant tissue culture materials.
5. Preparation of plant growth curve by measuring height over a period and plotting results.
6. Study of meristematic activity using permanent slides of root tips.
7. Observation of the effect of growth regulators (auxin/gibberellin) on seedling growth (visual/documentation-based).
8. Identification of major plant growth regulators and their uses in agriculture and horticulture.
9. Study of photoperiodic response in flowering plants: examples of SDP, LDP, and DNP plants.
10. Study of flower structure as a reproductive organ using dissected floral parts and diagrams.
11. Identification of pollination types and pollinators through flower adaptation and examples.
12. Study of fruit and seed formation stages with examples of parthenocarpy.
13. Measurement of plant growth parameters: plant height, leaf area, fresh and dry weight.
14. Identification and documentation of local plant diseases and their effects on plant development.

Bibliography

Reference/Text Books/Research Articles

1. Pandey, B.P. – *Botany for Degree Students* (Plant Physiology, Reproduction)
2. Vasishta, P.C. – *Plant Growth and Development*
3. Jain, V.K. – *Fundamentals of Plant Physiology*
4. Taiz, L. & Zeiger, E. – *Plant Physiology*
5. Kochhar, S.L. – *Economic Botany in the Tropics*
6. Kumar, H.D. – *Plant Tissue Culture*
7. Articles from *Journal of Ethnobotany and Economic Botany*

E-Contents / E-Books

1. NPTEL Online Courses (https://nptel.ac.in) – Plant Physiology and Development
2. e-PG Pathshala (https://epgp.inflibnet.ac.in) – Reproductive Biology and Growth Regulation
3. NCERT Biology Textbooks (Free Download – https://ncert.nic.in/ebooks.html)
4. Book: *Plant Growth and Development* by Bhattacharya (Available on Google Books)

Digital Resources & Weblinks

1. Botanical Survey of India (https://bsi.gov.in)
2. National Centre for Biotechnology Information (https://www.ncbi.nlm.nih.gov)
3. Plant Propagation Guide – Royal Horticultural Society (https://www.rhs.org.uk)
4. Plant Physiology Database – https://www.plantphysiol.org
5. Khan Academy Biology (https://www.khanacademy.org/science/biology)

Question Paper for External Practical Course on Investigations of Plant Life Sketch

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)				
Mn-Practical- 12	107225	Investigations of Plant Life Sketch	Max Marks: 25	Time: 4 Hrs.

Q.No.	Exercise	Marks
1.	Artificial propagation methods: grafting, budding and cuttings (demonstration any one method).	5
2.	Study of flower structure as a reproductive organ using dissected floral parts	5
3.	Measurement of plant growth parameters: leaf area, fresh and dry weight (Any one)	5
4.	Spotting (5 spot as per the practical list)	5
5.	External Viva Voce	5

Assessment Rubric for Internal Practical Course on Investigations of Plant Life Sketch

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)			
Practical-12	107225	Investigations of Plant Life Sketch	Max Marks: 25

S. No.	Assessment Criteria	Marks
1	Record/ Assignments	5
2	Attendance	5
3	Participation in Activity/ Field visit	5
4	Students overall performance	5
5	Internal Viva Voce	5

GOEC Theory: Wonders of Plant World

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107226	Wonders of Plant World	2	30	2 Hrs	30 (Ext.) 20 (Int)

Course Objectives:

- To identify various vegetative propagation methods like bulbs, runners, rhizomes, and suckers.
- To describe the process of growth at the cellular level, growth regulators, and their role in plant growth and development.
- To apply knowledge of photoperiodism and vernalization in controlling plant flowering and growth patterns.
- To analyze the various methods of pollination, fertilization, and post-fertilization development in angiosperms.
- To evaluate the significance of plant breeding techniques in enhancing plant growth, yield, and quality.

Course Outcomes:

- Identify and differentiate natural and artificial methods of plant propagation and their limitations.
- Explain the role of plant growth regulators, photoperiodism, and vernalization in plant growth and development.
- Apply various methods of measuring plant growth such as height, biomass, and growth index.
- Analyze the role of environmental factors, diseases, and stress conditions affecting plant growth.
- Evaluate the importance of plant breeding, tissue culture, and advanced growth methods in increasing plant productivity.
- Design and formulate plant growth assessments through case studies, growth measurement experiments, and practical demonstrations.
- Investigate the importance of greenhouses, polyhouses, and hydroponics in advanced plant growth.
- Develop practical skills in plant propagation, growth measurement, and plant breeding techniques.
- Implement advanced growth methods and develop solutions to counter plant stress and diseases.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
I	**Plant Wonders – Intelligence, Perception, and Communication**	8	8	Suitable pedagogical strategies are separately annexed
	1.1: Telegraph Plant (*Codariocalyx motorius*) – The Dancing Plant, Venus Flytrap (*Dionaea muscipula*) – The Electric Hunter			
	1.2: *Mimosa pudica* – The Plant That Remembers, *Boquila trifoliolata* – The Leaf Imitator			
	1.3: Tallest and Largest Sequoias - Sequoia sempervirens and Sequoiadendron giganteum			
	1.4: *Dracaena cinnabari* Dragon's Blood Tree,			

	Single Bloom Largest Flower *Rafflesia arnoldii*			
II	**Magnificent Products**	7	7	
	2.1: The Mystic Rhizome - *Curcuma caesia* (Black Turmeric), The Scented Scar - *Aquilaria malaccensis* (Agarwood)			
	2.2: The Billion-Dollar Orchid *Vanilla planifolia*, The Dangerous Healer – *Croton tiglium* (Jamalgota)			
	2.3: Ginseng – The Traditional Divine Medicine *Panax* Chinese, Australia, Korean and American The Pain and Peace Plant – *Papaver somniferum* (Opium Poppy)			
	2.4: Natural rooting hormone: *Salix tetrasperma* (Indian Willow)			
III	**Extreme Survivors: Masters of hostile environments**	7	7	
	3.1: The Two-Leafed Immortal: *Welwitschia mirabilis*, The Resurrection Plant: *Selaginella lepidophylla*			
	3.2: The Altitude Adapter: *Ephedra gerardiana,* The Extreme Cold Survivors: *Saussurea obvallata* (Brahma Kamal)			
	3.3: Saline Adapter: *Rhizophora mucronata* (Mangrove), Extreme Desert Dweller: *Lithops spp.* (Living Stones)			
	3.4: Watermeal fine plant: *Wolffia globosa*,			
IV	**Green Futuristic Instincts**	8	8	
	The Self-Cleaning Wonder: *Nelumbo nucifera* (Lotus Leaf), The Vegan Future: Duckweed (*Lemna minor*)			
	The Biofactory and Vaccine Generator Plant: *Nicotiana benthamiana* and Engineered *Nicotiana tabacum*			
	The Vitamin A Factory: Golden Rice, The Injectable-Free Immunity Plant: Potato Vaccine			
	Solar Panel Tracking Systems: *Helianthus annuus*, Artificial Photosynthesis in Hydrogen Fuel Technology			

Bibliography:

Books

1. Gupta, S. M. (1968). *Plant myths and traditions in India*. Munshiram Manoharlal Publishers.
2. Juyal, P. (2023). *Ethnobotany*. Uttarakhand Open University.
3. Kirtikar, K. R., & Basu, B. D. (1935). *Indian medicinal plants*. Allahabad: Lalit Mohan Basu.
4. Manandhar, N. P. (2002). *Plants and people of Nepal*. Timber Press.
5. Paroda, R. S., & Mal, B. (2001). *Plant genetic resources: Advances in conservation and utilization*. ICAR-NBPGR.

Research Articles (Peer-reviewed Journals)

1. Appenroth, K. J., Sree, K. S., & Böhm, V. (2017). Nutritional value of duckweeds (Lemnaceae) as human food. Food Chemistry, 217, 266–273. https://doi.org/10.1016/j.foodchem.2016.08.116
2. Attele, A. S., Wu, J. A., & Yuan, C. S. (1999). Ginseng pharmacology: Multiple constituents and multiple actions. Biochemical Pharmacology, 58(11), 1685–1693. https://doi.org/10.1016/S0006-2952(99)00212-9
3. Baluška, F., & Mancuso, S. (2009). Plants and animals: Convergent evolution in action? Plant Signaling & Behavior, 4(12), 1037–1040. https://doi.org/10.4161/psb.4.12.10317
4. Bhushan, B., Jung, Y. C., & Koch, K. (2009). Micro-, nano- and hierarchical structures for superhydrophobicity, self-cleaning and low adhesion. Philosophical Transactions of the Royal Society A, 367(1894), 1631–1672. https://doi.org/10.1098/rsta.2009.0011
5. Boquila trifoliolata mimics leaves of an artificial plastic host plant. (2021). Scientific Reports, 11, 2229. https://doi.org/10.1038/s41598-021-02229-8
6. Fernández, R. J., & Reynolds, J. F. (2000). Potential growth and drought tolerance of eight desert grasses: Lack of a trade-off? Oecologia, 123(1), 90–98. https://doi.org/10.1007/s004420050995
7. Gagliano, M., Renton, M., Depczynski, M., & Mancuso, S. (2014). Experience teaches plants to learn faster and forget slower in environments where it matters. Oecologia, 175(1), 63–72. https://doi.org/10.1007/s00442-013-2873-7
8. Gagliano, M., Vyazovskiy, V. V., Borbély, A. A., Grimonprez, M., & Depczynski, M. (2016). Learning by association in plants. Scientific Reports, 6, 38427. https://doi.org/10.1038/srep38427
9. Kala, C. P. (2005). Indigenous uses and structure of conservation of Saussurea obvallata (DC.) Edgew. in the Indian Himalayas. Biodiversity and Conservation, 14(4), 1073–1088. https://doi.org/10.1007/s10531-004-8411-0
10. Kumar, A., & Bharti, S. K. (2023). A comprehensive review with future prospects on the medicinal properties of Curcuma caesia Roxb. Journal of Ethnopharmacology, 298, 115777. https://doi.org/10.1016/j.jep.2022.115777
11. Landis, J. B., & Soltis, D. E. (2012). The evolutionary origin and diversification of Lithops (Aizoaceae): Insights from molecular phylogenetics. Taxon, 61(6), 1151–1163. https://doi.org/10.1002/tax.616004
12. Marsh, J. E. (1987). Welwitschia mirabilis: A living fossil. Botanical Review, 53(1), 1–80. https://doi.org/10.1007/BF02861083
13. Parida, A. K., & Jha, B. (2010). Salt tolerance mechanisms in mangroves: A review. Trees, 24(2), 199–217. https://doi.org/10.1007/s00468-010-0394-4
14. Patil, M. V., Patil, D. A., & Patil, S. R. (2009). Medicinal uses of Jayapala (Croton tiglium Linn.): A review. World Journal of Pharmaceutical and Medical Research, 5(6), 45–48.
15. Rybicki, E. P. (2010). Plant-made vaccines for humans and animals. Plant Biotechnology Journal, 8(5), 620–637. https://doi.org/10.1111/j.1467-7652.2009.00496.x
16. Sileshi, G. W., Nath, A. J., Giri, K., & Das, A. K. (2023). Modelling habitat suitability of the critically endangered agarwood (Aquilaria malaccensis) in India. Biodiversity and Conservation, 32, 123–138. https://doi.org/10.1007/s10531-023-02727-3
17. Sreelatha, U., & Reddy, V. R. (2013). Vanilla planifolia: An economically important orchid and its propagation. Journal of Medicinal Plants Research, 7(13), 761–767. https://doi.org/10.5897/JMPR12.1294

Research Papers / Reviews / Conference Articles

1. Appenroth, K. J., Sree, K. S., & Böhm, V. (2017). *Nutritional value of duckweeds (Lemnaceae) as human food*. *Food Chemistry*, 217, 266–273. https://doi.org/10.1016/j.foodchem.2016.08.116
2. Bhushan, B., Jung, Y. C., & Koch, K. (2009). *Micro-, nano- and hierarchical structures for superhydrophobicity, self-cleaning and low adhesion*. *Philosophical Transactions*

of the Royal Society A, 367(1894), 1631–1672. https://doi.org/10.1098/rsta.2009.0011
3. Parida, A. K., & Jha, B. (2010). *Salt tolerance mechanisms in mangroves: A review*. *Trees*, 24(2), 199–217. https://doi.org/10.1007/s00468-010-0394-4
4. Patil, M. V., Patil, D. A., & Patil, S. R. (2009). *Medicinal uses of Jayapala (Croton tiglium Linn.): A review*. *World Journal of Pharmaceutical and Medical Research*, 5(6), 45–48.
5. Sreelatha, U., & Reddy, V. R. (2013). *Vanilla planifolia: An economically important orchid and its propagation*. *Journal of Medicinal Plants Research*, 7(13), 761–767. https://doi.org/10.5897/JMPR12.1294

Weblinks

1. Britannica. (n.d.). *Telegraph plant | Description, Movement, & Facts*. https://www.britannica.com/plant/telegraph-plant
2. National Center for Biotechnology Information (NCBI). (n.d.). *Salix spp. medicinal properties*. https://www.ncbi.nlm.nih.gov
3. ResearchGate. (2021). *Boquila trifoliolata mimics leaves of an artificial plastic host plant*. https://www.researchgate.net/publication/349527181
4. Royal Botanic Gardens Kew. (n.d.). *The Plants of the World Online*. https://powo.science.kew.org
5. World Agroforestry Centre. (n.d.). *Species Profile: Aquilaria malaccensis*. https://www.worldagroforestry.org

Model Questions:

Unit -I

1-Mark Questions (Answer in one sentence)

1. What is the scientific name of the Telegraph Plant?
   टेलिग्राफ वनस्पतीचे शास्त्रीय नाव काय आहे?
2. Which plant is nicknamed "The Electric Hunter"?
   "इलेक्ट्रिक शिकारी" या टोपणनावाने ओळखली जाणारी वनस्पती कोणती?
3. Name the plant known for leaf-folding when touched.
   स्पर्श केला असता पाने मिटवणारी वनस्पती कोणती?
4. What is the special ability of Boquila trifoliolata?
   बोकीला ट्रायफोलियोलाटाची विशेष क्षमता काय आहे?
5. Which is the tallest tree species in the world?
   जगातील सर्वात उंच झाड कोणते?
6. Name the species called Dragon's Blood Tree.
   ड्रॅगनच्या रक्ताचे झाड म्हणून ओळखली जाणारी वनस्पती कोणती?
7. Which plant produces the world's largest single bloom?
   जगातील सर्वात मोठे एकल फूल देणारी वनस्पती कोणती?
8. Which plant exhibits leaf imitation behavior?
   पाने अनुकरण करणारी वनस्पती कोणती आहे?

3-Mark Questions (Short answers)

1. Describe the movement mechanism of the Telegraph Plant.
   टेलिग्राफ वनस्पतीतील हालचालीची यंत्रणा स्पष्ट करा.
2. Explain how Venus Flytrap responds to touch and why.
   व्हीनस फ्लायट्रॅप स्पर्शाला कसे प्रतिसाद देते आणि का?
3. Write a short note on memory-like behavior in *Mimosa pudica*.
   *मायमोसा पुडिका*मध्ये आढळणाऱ्या स्मृतीसारख्या वर्तनावर थोडक्यात माहिती द्या.
4. Describe the adaptive mimicry shown by *Boquila trifoliolata*.
   *बोकीला ट्रायफोलियोलाटा*ने दाखवलेले रूपानुकरणाचे अनुकूलन स्पष्ट करा.
5. Highlight the ecological and size-related marvel of *Sequoia sempervirens*.
   *सेक्वोया सॅम्परव्हायरेन्स*चे पर्यावरणीय व आकाराचे वैशिष्ट्य सांगा.
6. Write a note on the ecological uniqueness of *Dracaena cinnabari*.
   *ड्रॅसेना सिन्नाबारी*च्या पर्यावरणीय वैशिष्ट्यावर टिपण लिहा.

7. Discuss pollination-related features of *Rafflesia arnoldii*.
   *रॅफ्लेशिया अर्नोल्डी*च्या परागीकरणविषयक वैशिष्ट्यांवर चर्चा करा.

6-Mark Questions (Long Answer Type)

1. Compare and contrast intelligent behavior observed in Codariocalyx motorius, Mimosa pudica, and Dionaea muscipula with respect to plant perception and response.
   कोडॅरिओकॅलिक्स मोटोरियस, मायमोसा पुडिका, व डायोनेया मस्किपुला या वनस्पतींमध्ये आढळणाऱ्या बुद्धिमान वर्तनाची तुलना करा व स्पर्श/उत्तरे याबाबत चर्चा करा.

2. Explain in detail the concept of plant communication and mimicry with reference to Boquila trifoliolata and Mimosa pudica. बोकीला ट्रायफोलियोलाटा व मायमोसा पुडिका या वनस्पतींच्या उदाहरणासह वनस्पती संवाद व अनुकरण या संकल्पनांचे सविस्तर वर्णन करा.

3. Write an account on Sequoia sempervirens and Sequoiadendron giganteum, highlighting their size, age, ecological role, and significance in the plant kingdom. सेक्वोया सॅम्परव्हायरेन्स व सेक्वॉयाडेंड्रॉन जायंटियम या जगातील सर्वात उंच व विशाल वृक्षांबाबत त्यांचा आकार, वय, पर्यावरणीय भूमिका व वनस्पती राज्यातील स्थान स्पष्ट करा.

4. Describe the unique features of Rafflesia arnoldii and Dracaena cinnabari, emphasizing their reproduction, habitat, and ecological value. रॅफ्लेशिया अर्नोल्डी व ड्रॅसेना सिन्नाबारी या वनस्पतींच्या वैशिष्ट्यांवर प्रकाश टाका, त्यांच्या पुनरुत्पादन, अधिवास व पर्यावरणीय महत्त्व यावर चर्चा करा.

5. Discuss the idea of 'plant intelligence' with scientific explanation and examples from at least three species covered in this unit. 'वनस्पतींची बुद्धिमत्ता' या संकल्पनेचे वैज्ञानिक दृष्टिकोनातून स्पष्टीकरण द्या आणि या घटकातील किमान तीन वनस्पतींची उदाहरणे द्या.

Unit II: Magnificent Products

1-Mark Questions (Answer in one sentence)

1. Name the plant known as Black Turmeric.
   काळी हळद म्हणून ओळखली जाणारी वनस्पती कोणती?
2. What is agarwood obtained from?
   अगरवुड कोणत्या वनस्पतीपासून मिळवले जाते?
3. Which orchid is called the "Billion Dollar Plant"?
   "बिलियन डॉलरस प्लँट" म्हणून ओळखली जाणारी ऑर्किड कोणती?
4. Name the poisonous medicinal plant *Croton tiglium* is commonly known as.
   Croton tiglium या विषारी औषधी वनस्पतीचे सामान्य नाव काय आहे?
5. What is the source plant of Ginseng?
   जिनसेंग या वनस्पतीचा मूळ स्त्रोत कोणता आहे?
6. Name the narcotic plant that also provides pain relief.
   वेदना कमी करणाऱ्या आणि व्यसनाधीनतेस कारणीभूत ठरणाऱ्या वनस्पतीचे नाव सांगा.
7. Which Indian tree acts as a natural rooting hormone?
   नैसर्गिक मुळे निर्माण करणारे भारतीय झाड कोणते?

3-Mark Questions (Short answers)

1. Describe the medicinal and cultural importance of *Curcuma caesia*.
   कुर्कुमा कॅसिया (काळी हळद) याचे औषधी व सांस्कृतिक महत्त्व लिहा.
2. How is agarwood formed and what is its value?
   अगरवुड कसे तयार होते आणि त्याचे महत्त्व काय आहे?
3. Explain the economic importance of *Vanilla planifolia*.
   व्हॅनिला प्लॅनिफोलिया या ऑर्किडचे आर्थिक महत्त्व स्पष्ट करा.
4. Write a note on *Croton tiglium* as a dangerous healer.
   Croton tiglium ही धोकादायक औषधी वनस्पती यावर टिपण लिहा.
5. Describe the pharmacological properties of *Panax ginseng*.
   पॅनॅक्स जिनसेंग या वनस्पतीच्या औषधी गुणधर्मांचे वर्णन करा.

6. Write a short note on the uses and controversy around *Papaver somniferum*.
   पॅपॅव्हर सोम्निफेरम (अफू) याच्या उपयोगांवर व वादांवर टिपण लिहा.
7. Explain the significance of *Salix tetrasperma* in propagation.
   सॅलिक्स टेट्रास्पर्मा या वनस्पतीचा वनस्पती प्रसारात होणारा उपयोग स्पष्ट करा.

6-Mark Questions (Long answers)

1. Discuss the significance of plant-derived products with reference to *Vanilla*, *Croton*, and *Papaver*.
   व्हॅनिला, *क्रोटॉन* आणि *पॅपॅव्हर* या वनस्पतींच्या उदाहरणासह वनस्पती-जन्य उत्पादनांचे महत्त्व स्पष्ट करा.
2. Describe the chemistry and ethnobotany of *Ginseng* and *Agarwood*.
   जिनसेंग आणि *अगरवुड* यांचे रासायनिक व पारंपरिक उपयोग सांगा.
3. Explain the role of *Salix tetrasperma* and *Black Turmeric* in natural agriculture and wellness.
   सॅलिक्स टेट्रास्पर्मा व *काळी हळद* यांचा नैसर्गिक शेती व आरोग्य सुधारण्यात होणारा उपयोग स्पष्ट करा.

Unit III: Extreme Survivors

1-Mark Questions (Answer in one sentence)

1. Name the plant with only two persistent leaves.
   फक्त दोन कायमस्वरूपी पाने असलेली वनस्पती कोणती?
2. What is the resurrection plant known for?
   रिझरेक्शन प्लँट कोणत्या वैशिष्ट्यासाठी ओळखला जातो?
3. Name a gymnosperm adapted to high altitude.
   उंच प्रदेशात वाढणाऱ्या कोणत्या जिम्नोस्पर्मचे नाव द्या?
4. Which plant is called Brahma Kamal?
   "ब्रह्म कमळ" म्हणून ओळखली जाणारी वनस्पती कोणती?
5. Name a true mangrove species.
   खरी मॅन्ग्रोव्ह वनस्पती कोणती?
6. What are Lithops commonly known as?
   लिथॉप्स या वनस्पतींना सामान्यतः काय म्हणतात?
7. Which is the smallest flowering plant?
   सर्वात लहान फुलझाड कोणती आहे?

3-Mark Questions (Short answers)

1. Write a note on the survival strategy of *Welwitschia mirabilis*.
   व्हेलव्हिट्सिया मिरॅबिलिस या वनस्पतीची टिकून राहण्याची युक्ती लिहा.
2. Explain the drought resilience in *Selaginella lepidophylla*.
   सेलाजिनेला लेपिडोफायला या वनस्पतीची दुष्काळप्रतिकारक क्षमता स्पष्ट करा.
3. Describe cold survival adaptations in *Ephedra* and *Saussurea obvallata*.
   इफेड्रा व *सॉसुरिया ऑबव्हॅलेटा* यामधील थंडीच्या अनुकूलतेचे वैशिष्ट्ये स्पष्ट करा.
4. Write a note on salt-tolerance in *Rhizophora mucronata*.
   रायझोफोरा म्युक्रोनेटा मधील क्षार सहनशीलतेचे वैशिष्ट्य स्पष्ट करा.
5. Discuss the desert mimicry of *Lithops spp.*
   लिथॉप्स मध्ये आढळणारे वाळवंटी नकलन स्पष्ट करा.
6. Describe the biological simplicity and utility of *Wolffia globosa*.
   वोल्फिया ग्लोबोसा ची जैविक रचना आणि उपयोगिता स्पष्ट करा.

6-Mark Questions (Long answers)

1. Compare adaptations in *Welwitschia*, *Selaginella*, and *Lithops* in harsh environments.
   व्हेलव्हिट्सिया, *सेलाजिनेला*, आणि *लिथॉप्स* यांच्या कठीण परिस्थितीत टिकून राहण्याच्या वैशिष्ट्यांची तुलना करा.
2. Discuss physiological and morphological adaptations in saline and alpine plants.
   क्षारीय व थंड हवामानातील वनस्पतींमधील शारीरिक व रचनात्मक अनुकूलतेची चर्चा करा.
3. Evaluate the ecological role of extreme survivors in biodiversity conservation.
   टिकाऊ वनस्पतींचे जैवविविधतेच्या संवर्धनातील योगदान स्पष्ट करा.

Unit IV: Green Futuristic Instincts

1-Mark Questions (Answer in one sentence)

1. Name the plant known for its self-cleaning leaf surface.
   स्वयं-स्वच्छ पानांचा पृष्ठभाग असलेली वनस्पती कोणती?
2. Which aquatic plant is considered a vegan protein source?
   वनस्पती आधारित प्रथिनांचा स्रोत असलेली जलीय वनस्पती कोणती?
3. Name the plant used in vaccine production via biotechnology.
   जैवतंत्रज्ञानाद्वारे लसीकरणासाठी वापरली जाणारी वनस्पती कोणती?
4. What is Golden Rice rich in?
   गोल्डन राईस मध्ये कोणता पोषक घटक मुबलक प्रमाणात असतो?
5. Which common plant shows heliotropic tracking of the sun?
   सूर्याच्या दिशेनुसार हालचाल करणारी सामान्य वनस्पती कोणती?
6. What biological process inspired artificial photosynthesis?
   कृत्रिम प्रकाशसंश्लेषणासाठी प्रेरणा देणारी नैसर्गिक प्रक्रिया कोणती?
7. Which plant is used to produce edible vaccines?
   खाण्यायोग्य लस निर्माण करणाऱ्या वनस्पतीचे नाव काय आहे?

3-Mark Questions (Short answers)

1. Describe the nano-structural properties of the lotus leaf.
   कमळाच्या पानांची सूक्ष्म संरचनात्मक वैशिष्ट्ये लिहा.
2. Write a note on the protein and biomass value of *Lemna minor*.
   लेम्ना मायनर या वनस्पतीतील प्रथिने व जैवभाराचे महत्त्व स्पष्ट करा.
3. Explain how *Nicotiana benthamiana* is used in biotechnology.
   निकोटियाना बेंथमियाना जैवतंत्रज्ञानात कसा वापरला जातो ते लिहा.
4. What is Golden Rice and why is it important?
   गोल्डन राईस म्हणजे काय आणि ते महत्त्वाचे का आहे?
5. Describe the working of *Helianthus annuus* as a natural sun tracker.
   हेलिअंथस अॅन्युअस ही वनस्पती सूर्याचा मागोवा कशी घेते ते स्पष्ट करा.
6. Write a short note on artificial photosynthesis in energy tech.
   उर्जासंबंधी तंत्रज्ञानात कृत्रिम प्रकाशसंश्लेषणाचे महत्त्व लिहा.

6-Mark Questions (Long answers)

1. Discuss how futuristic plant traits are being adapted for food, energy, and medicine.
   अन्न, ऊर्जा आणि औषधासाठी वनस्पतींच्या भविष्यवादी गुणधर्मांचा कसा उपयोग केला जात आहे ते स्पष्ट करा.
2. Describe the concept and applications of bioengineered plants with reference to *Potato Vaccine* and *Golden Rice*.
   पोटॅटो लस व *गोल्डन राईस* यांच्या उदाहरणासहित जैव-यांत्रिकृत वनस्पतींचे महत्त्व स्पष्ट करा.
3. Explain the role of *Nelumbo nucifera*, *Lemna*, and *Nicotiana* in sustainable and innovative botany.
   नेलंबो, *लेम्ना* व *निकोटियाना* या वनस्पतींची शाश्वत व नाविन्यपूर्ण वनस्पतीशास्त्रातील भूमिका स्पष्ट करा.

VSC: Nursery and Garden Management

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107227	Nursery and Garden Management	2	60	4 Hrs	50

Course Objectives:

1. To create opportunities for self-employment/student startup through Nursery and Garden Management.
2. To enrich students' training and knowledge that would be useful in the nursery and garden so that the stockholder will get a good profit.
3. To create awareness among nursery and garden developers or managers.

Course Outcomes:

1. Understand the Scope of Nursery and Garden Management.
2. Demonstrate different methods of plant propagation.
3. Understand: The concept of nursery and garden layout and planning.
4. Acquire knowledge about designing, maintenance, and landscaping
5. Analyze marketing, budgeting, and inventory management for a nursery business.
6. Design sustainable methods for nursery and garden management.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Nursery Management**	15	12	Suitable pedagogical strategies are separately annexed
	1.1 Importance and scope of nurseries			
	1.2 Types of nurseries: Retail, wholesale, specialized, and home nurseries.			
	1.3 Selection of site for nursery establishment Preparation of nursery beds and its types			
	1.4 Layout and infrastructure: Propagation structures (greenhouses, shade nets, polyhouse etc)			
Unit II	**Garden Management Principles**	15	12	
	2.1 Types of gardens: Botanical, terrace gardens and kitchen garden			
	2.2 Garden component and tools: Lawns, hedges, shrubs, climbers, trees, flower beds and uses of tools			
	2.3 Garden maintenance: Soil mixture. Watering, pruning, weeding, manuring, pest and disease management.			
	2.4 Seasonal planting and rotation in gardens.			
Unit III	**Commercial Aspects and Sustainable Practices**			
	3.1 Nursery Business Management: Financial planning (cost management, pricing) production, marketing and record-keeping			
	3.2 Government Policies & Regulations: Government schemes, Licensing, certifications and compliance requirements for nursery and garden businesses.			
	3.3 Sustainable Practices: Organic media, water conservation, bio-manure preparation, solar-powered equipment and eco-friendly packaging alternatives.			
	3.4 Modern Technologies: Drip irrigation, Sprinkler, rain pipe, hydroponics, and vertical gardening.			

Unit IV	Entrepreneurship in Nursery Management			
	4.1 Planning & Establishing a Nursery: Financial management and sourcing.	15	14	
	4.2 Marketing & Branding: Online and offline marketing, customer management and sales strategies.			
	4.3 Project Management & Documentation: Business models, project proposals, nursery records and inventory management.			
	4.4 Practical Project: Creating a business plan for a nursery startup.			

Practical:

Conduct at least three Exercises from Each Unit of the following:

Unit I:

1. Design and prepare a basic nursery layout.
2. Preparation of Nursery beds (type of bed-flat /raised)
3. Study the construction and maintenance of propagation structures (poly houses/shade nets/ Green house)
4. Test and document soil pH and nutrient content for nursery use.

Unit II:

5. Design small garden layouts incorporating lawns, flower beds, and pathways.
6. Perform maintenance activities: Lawn mowing, pruning, weeding, and pest control.
7. Propagate ornamental plants using appropriate techniques.
8. Demonstration of tools use in garden
9. To understand the design principles, features and maintenance practices of different types of gardens

Unit III:

10. Prepare a step-by-step plan for obtaining nursery certifications.
11. Licensing & Legal Documentation Simulation for Nursery Setup
12. Preparation of Organic Potting Mix & Bio-Manure
13. Pest & Disease Control Using Organic Methods (Neem oil, bio-pesticides, etc.).
14. Ecofriendly packaging of saplings
15. Demonstration on Vertical Gardening
16. Hydroponics Demonstration

UNIT IV :

17. Developing a Business Plan for a Nursery Startup
18. Branding & Packaging for Nursery Plants
19. Market Survey & Pricing Analysis of Nursery Products
20. Customer Interaction & Sales Strategy Role-Play

Conduct at least TWO Activities from the following:

Field visits:

1. Visit a commercial nursery or garden to study operations.

Other activities –

1. Prepare a list of plants that are on high demand in nursery
2. Case Study on Government Nursery Policies & Subsidies
3. Nursery Market Survey & Pricing Analysis
4. Preparation Garden inspection report
5. Organize a workshop or hands on training

Collaboration/ MoU-

Conduct suggested activities in Collaboration / MoU with any Nursery / related NGO/ Garden.

References:

Digital Resources

- Food and Agriculture Organization (FAO). (2021). *Smart nursery technologies for sustainable horticulture*. http://www.fao.org
- Government of India. (2023). *Guidelines on nursery and horticulture schemes*. Ministry of Agriculture & Farmers Welfare. https://agricoop.nic.in
- NABARD. (n.d.). *Financing models and subsidies for nursery businesses in India*. https://www.nabard.org
- United Nations Development Programme (UNDP). (2022). *Green business models for nursery and garden management*. https://www.undp.org
- Agri-Entrepreneurship Development Institute. (n.d.). *Startup support for horticulture and nursery businesses*. https://www.msme.gov.in

Reference Books

- Adams, C. R., & Early, M. P. (2005). *Principles of horticulture*. Butterworth-Heinemann.
- Bansil, P. C. (2008). *Horticulture in India*. CBS Publishers.
- Basra, A. S. (2007). *Handbook of seed science and technology*. Scientific Publishers.
- Bose, T. K., & Mukherjee, D. (2004). *Gardening in India*. Oxford Book Company.
- Glover, J. (2019). *Nursery business management: Financial planning and marketing strategies*. CABI Publishing.
- Hartmann, H. T., & Kester, D. E. (2010). *Plant propagation: Principles and practices*. Prentice Hall.
- Jagdishwar, S. (2021). *Advances in horticultural plant propagation and nursery techniques*. Springer.
- Randhawa, G. S., & Mukhopadhyay, A. (1986). *Floriculture in India*. Allied Publishers.
- Rao, V. S. (2017). *Entrepreneurship in agriculture and nursery management*. Oxford & IBH Publishing.
- Veena, A. (2007). *Nursery and landscaping*. Agrobios (India).
- Vinod, K. (1999). *Nursery & planting practices in forestry (2nd ed.)*. Scientific Publishers.
- Walker, S., & Phillips, M. (2018). *Eco-friendly nursery practices and sustainable landscaping*. Taylor & Francis.

Textbooks

- Krishnamurthy, H. (2018). *Greenhouse technology and vertical gardening*. Agrotech Publishing.
- Mishra, A. (2021). *Sustainable packaging solutions for nursery plants*. Springer.
- Patel, D. (2019). *Marketing strategies for plant nurseries: A case study approach*. Allied Publishers.
- Rajan, S. (2020). *Protected cultivation and nursery technologies*. Agrobios.
- Sharma, P. (2019). *Integrated pest and disease management for nurseries and gardens*. New India Publishing.
- Singh, R., & Kaur, P. (2022). *Modern irrigation technologies for nurseries and gardens: A practical guide*. ICAR.

Research Articles

- Gupta, M., & Yadav, V. (2021). *Economic feasibility of plant nursery businesses in India*. *Journal of Agri-Economics, 14*(2), 135-150.
- Khandelwal, P., & Bose, A. (2020). *The role of digital marketing in nursery business growth*. *International Journal of Horticultural Business, 10*(3), 87-102.
- Verma, R., & Joshi, D. (2022). *Impact of government subsidies on the nursery sector: A case study of Indian horticulture*. *Horticulture Research & Development, 8*(1), 56-73.

National Case Studies

- Government of India. (2023). *Case study on the impact of government subsidies on small-scale nursery businesses in India*. Ministry of Agriculture & Farmers Welfare.

- ICAR. (2022). *The role of modern irrigation techniques in nursery management: A case study from Karnataka*.
- NABARD. (2021). *The success story of agri-startups in the nursery sector: Case studies from Maharashtra and Punjab*.
- Patel, S. (2020). *Digital marketing strategies for plant nurseries: A case study from Gujarat*.

International Case Studies

- Asian Development Bank. (2022). *The impact of government incentives on nursery entrepreneurship in Southeast Asia*.
- European Horticulture Society. (2021). *Sustainable packaging solutions in the plant nursery industry: A study from Germany and the Netherlands*.
- FAO. (2019). *Drip irrigation and water conservation in nursery management: A case study from Israel*.
- USDA. (2022). *Best practices in greenhouse nursery management: Lessons from the USA and Canada*. United States Department of Agriculture

Pedagogies

1. **Entrepreneurial Project Development,** where students ideate, develop, and present a business plan related to the Nursery and garden. This pedagogy combines market research, product development, and strategic planning.
2. **Mentorship Programs with professional experts** can provide personalized guidance, enhancing entrepreneurial skills and network building. These methods offer practical insights into business development, encouraging innovation and real-world application of course concepts.
3. **Project-Based Learning (PBL):** Engages students in real-world nursery industry projects, enhancing their understanding and skills in a practical context.
4. **Flipped Classroom:** Utilizes online resources for theory, freeing up classroom time for interactive discussions, practical exercises, and guest lectures from industry professionals.
5. **Simulation Games and Virtual Labs:** Offers hands-on experience in nursery and garden development processes without the need for physical resources.
6. **Case Studies and Role Plays:** Encourages critical thinking and problem-solving through analysis of real-world challenges in the seed industry.
7. **Internships and Industry Visits:** Provides firsthand experience and insight into the operational aspects of nursery and Garden management.

Question Paper for Internal VSC Practical

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)			
Practical-13	Course Code 107227	Nursery and Garden Management	Max Marks: 50

Q. No.	Exercise	Marks
1	Demonstration of any one activity from the activity list (any one)	10
2	Design Nursery / Garden layout as per requirements & area	5
3	Prepare business plan / Startup plan for nursery or Garden	5
4	Comment tools and equipment used in garden management (any two)	5
5	Attendance & overall Performance throughout the semester	10
6	Record Book / Activity book	5
7	Field visit / Activities under MoU or Collaboration- report	5
8	Viva Voce	5
	Total	50

SEC: Skilling Botanists for Nursery and Garden Management

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107228	Skilling Botanists for Nursery and Garden Management	2	60	4 Hrs	50

Course Objectives:

- To provide students with a comprehensive understanding of nursery and garden management.
- To develop practical skills in plant propagation, nursery establishment, and garden maintenance.
- To prepare students for careers in horticulture, landscaping, and related fields

Course Outcomes:

1. Understand basics of nursery and garden management.
2. Apply sexual and asexual propagation techniques.
3. Analyze factors affecting propagation and manage nursery records.
4. Select nursery site and use digital tools for layout planning.
5. Identify and plan nursery infrastructure.
6. Perform soil preparation, irrigation, pruning, and weeding.
7. Practice organic gardening and integrated pest management.
8. Maintain biodiversity, hygiene, and systematic record-keeping.

Unit System	Contents	Workload Allotted (Hrs)	Weightage of Marks Allotted	Incorporation of Pedagogies
Unit I	**Introduction to Nursery and Garden Management**	15	12	Suitable pedagogical strategies are separately annexed
	1.1 Overview of nursery and garden management			
	1.2 Role of nurseries in garden management			
	1.3 Nurseries: horticultural, forestry and ornamental, etc.			
	1.4 Basic concepts of garden design and layout			
Unit II	**Plant Propagation Techniques**	15	12	
	2.1 Sexual propagation: Seed collection, storage, and germination.			
	2.2 Asexual propagation: Cutting, grafting, budding, layering, and tissue culture.			
	2.3 Factors Affecting Propagation Success.			
	2.4 Basic costing, marketing of saplings, nursery record-keeping.			
Unit III	**Nursery Establishment and Management**	15	12	
	3.1 Site selection and preparation. Technology Tools: Mobile apps like Google SketchUp or Canva for garden design, sensors and automation kits			
	3.2 Infrastructure requirements (greenhouses, shade houses, irrigation systems)			
	3.3 Soil and media preparation, Soil preparation and fertilization, Irrigation and water management, Efficient irrigation techniques, Pruning, weeding, and			
	3.4 Nursery hygiene and pest management.			
Unit IV	**Sustainable Practices in Nursery and Garden Management**			
	4.1 Organic gardening practices, Composting and Organic Fertilizers, Natural Pest	15	12	

	4.2 Use of renewable resources and recycling, Integrated Pest Management (IPM)			
	4.3 Role of biodiversity in garden ecosystems			
	4.4 Maintain proper hygiene and record-keeping in nursery operations.			

Practical:

Conduct at least three Exercises from Each Unit of the following:

Unit I:

1. Design and prepare a nursery layout (Forest / Horticulture/ Ornamental any one)
2. Study the layout and infrastructure of a well-maintained garden.
3. Survey and Documentation of Local Nurseries
4. Classification and Tagging of Nursery Plants
5. Preparation and Maintenance of Nursery Records
6. Drawing a Basic Garden Layout on Graph Paper
7. Creation of a Miniature Garden Model

Unit II:

1. To Collect seeds from local plants and prepare them for sowing.
2. To Sow seeds in seed trays and monitor germination rates.
3. Practice stem cutting, leaf cutting, and root cutting on plants like rose, money plant, and coleus.
4. Perform grafting (e.g., wedge grafting in mango) and budding (e.g., T-budding in roses).

Unit III:

1. Site Selection and Layout Planning Using Mobile Apps (Google SketchUp/Canva)
2. Design and Setup of a Model Greenhouse or Shade House
3. Demonstration of Efficient Irrigation Techniques (Drip/Sprinkler Systems)
4. Pruning, Weeding, and Maintenance Practices in Nursery Plants
5. Assessment and Application of Nursery Hygiene and Pest Control Measures
6. Prepare different potting mixes using soil, sand, compost, and cocopeat
7. Preparation of Organic Potting Mix & Bio-Manure
8. Demonstration on Set up a rainwater harvesting system for garden use.

UNIT IV:

1. Demonstrate mulching to reduce water evaporation
2. Identify beneficial insects and their role in pest control.
3. Prepare compost using kitchen waste, garden waste, and cow dung
4. Demonstrate vermicomposting using earthworms.

Conduct at least TWO Activities from the following:

Field visits:

1. Visit a commercial nursery or garden to study operations.

Other activities –

1. Visit commercial nurseries, organic farms, and public gardens to observe best practices.
2. Visit local horticulture departments or agricultural universities for hands-on training and resources.
3. Prepare a budget for setting up a small nursery or garden

Collaboration/ MoU-

Conduct suggested activities in Collaboration / MoU with any Nursery / related NGO/ Garden.

References:

Reference Books:

1. Adams, C. R., Bamford, K. M., & Early, M. P. (2008). Principles of horticulture (5th ed.). Routledge.
2. Clarke, G. (2001). The complete book of plant propagation. Lorenz Books.
3. Forest Development Corporation of Maharashtra. (n.d.). Horticulture plant nursery handbook. https://www.fdcm.nic.in/PDF/horticulture%20plant%20nursery.pdf
4. Gupta, S. M. (1968). Plant myths and traditions in India. Munshiram Manoharlal Publishers.
5. Kumar, N. (2014). Introduction to horticulture (2nd ed.). Rajalakshmi Publications.

6. Kumar, V. (1999). Nursery and planting practices in forestry (2nd ed., pp. 110–158). Scientific Publishers.
7. Lal, D., Nayyer, M. A., Meena, J. K., & Meena, D. C. (2023). Nursery management & horticultural crops. Satish Serial Publishing House. https://www.satishserial.com/book/9789394023864/nursery-management-horticulture-crops
8. Lokare, P., & Keshamma, E. (2021). Plant nursery development & management: An innovative way of self-employment. Pothi Self-Publishing. https://store.pothi.com/book/priya-lokare-plant-nursery-development-management/
9. Manandhar, N. P. (2002). Plants and people of Nepal. Timber Press.
10. Manjunath, B. T. (2023). Nursery management and gardening (Course document). Scribd. https://www.scribd.com/document/837010832/NURSERY-MANAGEMENT-AND-GARDENING-1
11. Simeone, V. A. (2008). Sustainable gardening: The new organic growing. Creative Homeowner Press.
12. Singh, A. K. (2011). Nursery management: A guide to plant propagation and nursery establishment. Agrotech Publishing Academy.
13. Whitman, A., DeJohn, S., & The National Gardening Association. (2009). Organic gardening for dummies. Wiley Publishing.
14. YCMOU School of Agricultural Sciences. (n.d.). Resource book on horticulture nursery management. Yashwantrao Chavan Maharashtra Open University.

Pedagogies

1. **Entrepreneurial Project Development,** where students ideate, develop, and present a business plan related to the Nursery and garden. This pedagogy combines market research, product development, and strategic planning.
2. **Mentorship Programs with professional experts** can provide personalized guidance, enhancing entrepreneurial skills and network building. These methods offer practical insights into business development, encouraging innovation and real-world application of course concepts.
3. **Project-Based Learning (PBL):** Engages students in real-world nursery industry projects, enhancing their understanding and skills in a practical context.
4. **Flipped Classroom:** Utilizes online resources for theory, freeing up classroom time for interactive discussions, practical exercises, and guest lectures from industry professionals.
5. **Simulation Games and Virtual Labs:** Offers hands-on experience in nursery and garden development processes without the need for physical resources.
6. **Case Studies and Role Plays:** Encourages critical thinking and problem-solving through analysis of real-world challenges in the seed industry.
7. **Internships and Industry Visits:** Provides firsthand experience and insight into the operational aspects of nursery and Garden managment.

Question Paper for Internal Practical of SEC Skilling Botanists for Nursery and Garden Management

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)			
Practical-14	Course Code – 107228	Skilling Botanists for Nursery and Garden Management	Max Marks: 50

Q.N.	Exercise	Marks
1	Demonstration of any one activity from the activity list (any one)	10
2	Design Nursery / Garden layout as per requirements & area	5
3	Prepare business plan / Startup plan for nursery or Garden	5
4	Comment tools and equipment in garden management (any two)	5
5	Attendance & overall Performance throughout the semester	10
6	Record Book / Activity book	5
7	Field visit / Activities under MoU or Collaboration- report	5
8	Viva Voce	5
	Total	50

Field Project / Community Engagement Services in Botany: Phase-II

Level	Semester	Course Code	Course Name	Credits	Teaching Hours	Exam Duration	Max Marks
5.0	IV	107229	Field Project / Community Engagement Services in Botany: Phase-II	2	60	--	50

Course Objectives:

- To deepen field-based understanding of plant ecology, conservation practices, and community-linked botanical knowledge.
- To engage students in solving real-world problems through plant-based interventions and sustainability projects.
- To promote botanical innovation and outreach via community collaboration.
- To enhance project planning, execution, documentation, and dissemination skills.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Design and implement field-based botanical studies and service projects.
- Collaborate with rural/urban communities in addressing ecological challenges.
- Apply indigenous and scientific botanical knowledge for sustainable outcomes.
- Reflect on the social, ethical, and ecological impact of their interventions.
- Present findings effectively through reports, posters, and public engagement.

Guidelines/ SoP for FP/CEP

For understanding key principles of CE, forms of CE, operational guidelines and implementation strategy please refer https://www.ugc.gov.in/pdfnews/4187860_Revised-Final-Guidelines.pdf

As per NEP 2020, students of B Sc. II of Semester III and IV need to perform a Field Project (FP) for TWO (2) credits i.e. 50 Marks.

The guidelines regarding the field project are as follows:

Phase-I was about observation; Phase II is about transformation. This stage should empower students not just to study nature with curiosity, but to engage with communities in stewardship—even in small, humble ways.

Project Format and Deliverables

Component	Description
Duration	60 hours total (fieldwork + report writing + presentation)
Group Size	Individual or up to 4 students
Guide	Supervised by departmental faculty
Project Types	Survey-based, experimental, participatory, or interventionist
Final Output	Written report + Presentation + Community feedback
Evaluation	Internal (faculty) + External (appointed examiner) = 50 marks

Suggested Methodology:

Students should:

- **Revisit and reflect on Phase I**: What was observed? What problems or patterns emerged?
- **Identify upgrade paths**:

Phase I Focus	Phase II Upgrade
Documentation of medicinal plants	Trial plantation or awareness campaign
Survey of native species	Conservation/restoration initiative
Awareness posters on leafy greens	Live demos, kitchen gardens, nutrition drives
Soil/compost testing	Pilot cultivation trials in community

Suggested Project Types & Methodology

1. Problem-Solving/Intervention Projects

- **Define a tangible issue** (e.g., low seed germination, poor plant health, monoculture cropping).
- Design and implement a **simple solution**: improved propagation method, vermicompost trial, native seed packets, etc.
- Use **before–after comparisons** or **control vs treatment plots**.

2. Community Co-Creation

- Collaborate with **local SHGs, farmers, school eco-clubs**, or NGOs.
- Involve them in designing part of the project (planting, seed saving, garden design).
- Document shared knowledge and reciprocal learning.

3. Extended Surveys with Action

- Move from just documenting (Phase I) to **evaluating & advising**:

e.g., from "plants used by tribal communities" to "reviving forgotten uses through school campaigns."

Or from "identifying rare species" to "creating signage for local plant trails."

Field Protocol (Concise Steps)

1. **Reassess Phase I findings:** What insights, gaps, or opportunities emerged?
2. **Design upgrade:** Choose a focus: ecological impact, community outreach, practical testing and finalize objectives, participants, tools, and timeline
3. **Execute fieldwork:** Collect refined data and Conduct activities: planting trials, awareness sessions, school visits, community experiments
4. **Monitor & Record:** Use datasheets, photos, interviews, impact logs
5. **Analyse:** Compare results or outcomes (even in basic visual/statistical form)
6. **Document & Present:** Full report + visual presentation, Include community reflection or feedback if possible

Field-Based Work:

- Continued/advanced study from Phase-I or a fresh topic.
- Emphasis on data collection, analysis, and solution prototyping.

Report Format (Minimum 6 pages excluding Title, Certificate, Acknowledgement and appendices):

1. Title Page
2. Certificate
3. Acknowledgement
4. Main Report:
5. Introduction
6. Objectives
7. Methodology
8. Observations/Data
9. Discussion
10. Suggestions/Interventions
11. Conclusion
12. References

Example Upgrade Paths:

Phase I Topic	Phase II Upgrade
Medicinal plant documentation	Set up herbal home gardens or community demo plots
Compost testing	Promote low-cost compost units & track uptake
Awareness posters in schools	Interactive workshops & hands-on sessions
Survey of endangered species	Start digital herbarium or seed bank initiative

Suggested Project Themes:

Applied Botanical Solutions:

1. Designing a model medicinal garden in school or panchayat land
2. Seed bank or seed exchange initiatives for native/neglected crops
3. Botanical survey and mapping of urban green corridors

Experimental Community Work:

1. Demonstrating effects of composting methods on plant growth
2. Testing native vs hybrid seeds in vegetable gardens
3. Cultivation of insect-repelling plants and documentation of outcomes

Outreach and Advocacy:

1. Conducting awareness drives in schools/panchayats on medicinal plants
2. Publishing plant-care brochures in vernacular language
3. Training SHGs (Self Help Groups) on nursery skills or organic gardening

Ethics & Logistics

- Ensure voluntary community participation and informed consent.
- Avoid projects that may involve sensitive ecological areas or protected species without permissions.
- Encourage documentation in regional languages where applicable.

Assessment Rubric for FP/CEP Phase-II

SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI PRACTICAL EXAMINATION B.Sc. II (Botany), SEMESTER – IV (NEP)			
FP/CEP	**Course Code:** 107229	Field Project / Community Engagement Services in Botany: **Phase-II**	**Max Marks:** 50

Q. No.	Exercise	Marks
1	Field Engagement & Application of Knowledge	10
2	Quality of Intervention/Innovation	10
3	Documentation & Report Writing	10
4	Outcome of the Project Work	10
5	Oral/Poster Presentation	10